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# NEW THEORY

OF

# PHYSICAL ASTRONOMY,

ESTABLISHED UPON ANALOGY,

AND THE

*LAWS OF CHEMICAL ACTION.*

By ALEXANDER WATT,
AUTHOR OF A NEW THEORY OF OPTICS.

" Est quoddam prodire tenus si non datur ultra."
HORACE.

JAMAICA:

PRINTED AT THE OFFICE OF THE KINGSTON CHRONICLE.

1825.

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# PREFACE.

In submitting the following *Theory of Physical Astronomy* to the World, the Author cannot refrain from expressing a hope that, even should it be found to possess but little intrinsic merit, yet, if he shall have succeeded in showing that the existing doctrine upon this subject has its fallacies, it may not be considered that his labour has been bestowed in vain.

# INTRODUCTION.

THE Works of the Omnipotent have, from the earliest ages of the world, excited astonishment and awe, and, at the same time, a desire in mankind to search into the causes that could produce such wonders.

In the barbarous ages mankind were overwhelmed with what they could not comprehend, yet, conscious of something superior to themselves, to which all things owed their existence, kneeled down and worshipped God in his works. No savage nation has ever been discovered which has not betrayed a similar conviction, of which a more striking instance cannot be adduced than the nations of Indians in America.

In what glaring colours then does not this paint the folly of those of the present day who, with all the advantages of the effulgent light which has been thrown upon the certainty of the existence of a Supreme Being, from the

evidence of his wonderful works, still argue (for disbelieve they cannot) in refutation of the Divine word, and against the existence of a First Cause.

Few, however, I am happy to say, have been found to have prostrated their reason at the altar of their passions; and that there ever should have been men of exalted talents to have attached the influence of their names to such false doctrines cannot be too much regretted, although, on examination, it will be found that they all made such retribution, in their last moments, as, to their utter regret, and dismay, their limited time would allow.

Instead of the period of their frantic effusions being entitled to the appellation of the age of reason, it ought to have been distinguished as the period of her occultation, or madness, for she should have been satisfied (if to err) to err on the safe side.

So far was it from being the age of reason that, could their efforts have proved successful, the first step would have been taken to bereave us of her empire over us, for, take away the foundation of our hopes of future bliss, what have we left to support us in adversity, when we could not exclaim with Job, in the fervour of our hearts—

"For I know that my Redeemer liveth, and that he shall stand at the latter day upon the earth.

"And though after my skin worms destroy *this body*, yet in my flesh shall I see God;

"Whom I shall see for myself, and my eyes shall behold, and not another; though my veins be consumed within me."*

It has been conceived that, the more we comprehend the agency employed by the Almighty in producing the wonders of nature, the more the mystery being done away with, the more will our ideas of his omniscience and omnipotence be lessened: This, however, to the reflecting mind cannot be the case, for after all the weak efforts of man he is still left in mystery, for we see the Sun and Light, are sensible of an atmosphere, its expansion and condensation, we see and feel water, earth, and stone, but as we cannot arrive at a knowledge of the constitution of the elements, of which they are composed, where are we?

Let us reflect on our own mechanism, and we shall see the hand of God, and that no less power could have accomplished it; for, throughout the whole of our system a complete continuity, and an universal sympathy exist; let us in particular reflect on the effects produced by our senses—our seeing, hearing, &c. and our judgment from a combination of them all.

We know how the images of objects are depicted on the retina of the eye, for that we can exemplify by means of the Camera Obscura, but how do we become sensible of this effect, or, in other words, how do we see? None can ever know but God himself.

* Job, Chap. XIX. ver. 25. 27.

If we reflect on the vast inconceivable expanse of the Universe, the spherical opaque bodies that revolve therein, supported by—something—nothing—by the very atmosphere in which they are moved; the immense distance of the Stars, and even that, beyond them, there is no end to space, or number to Suns, and Worlds, we shall involuntarily look from nature unto nature's God, in awe, gratitude, and adoration.

I shall first give a brief retrospective view of the different systems which have influenced the opinions of the world at different periods, as to the laws that were supposed to regulate our Solar system, which will shew the progressive expansion of the human intellect upon that subject, and the efforts it has made to unravel the mystery which has, and ever must, even after genius shall have made her highest flights, veil the first principle employed by the Almighty in the creation of his incomprehensible works.

I shall afterwards give a description of the distinctive features of the system of Sir Isaac Newton, and finally state the chemical principles, upon which I, in part, ground my Theory.

## COMPENDIOUS HISTORY OF THE DIFFERENT SYSTEMS OF PHYSICAL ASTRONOMY.

Pythagoras, who was born 580 year, A. C., was the first who demonstrated, from the different altitudes of the stars at different places, that the earth was round, and he admitted that there might be Antipodes on the opposite side of the Globe. He considered the Planet Venus as a morning and evening Star, and conceived the Universe to be composed of twelve different spheres, viz.: The sphere of the Stars, of Jupiter, of Mars, of Mercury, of Venus, of the Sun, and of the Moon, and these were again succeed by the spheres of Fire, Air, Water, and the Terrestrial Globe; the plurality of worlds, suggested by Anaxagoras, was likewise admitted by Pythagoras.

He supposed that the Planets were fixed in solid spheres, and that they ought, during their revolutions, to emit sounds proportional to their mutual distances, but that the celestial concert, so loud and grand, was not audible to the feeble human organ; the distinguishing tenet of the Pythagorean school, however, was the diurnal revolution of the Earth, and its annual motion round the Sun, which they supposed to occupy the centre of the planetary system; this opinion, however, so opposite to vulgar prejudice, seems to have been adopted, rather as a

probable hypothesis, which explained the phenomenon, than as an incontestible truth, founded on observation. The fate of Anaxagoras, however, who, with his family, was proscribed for holding forth doctrines at variance with public opinion, and which was only transmuted to banishment, at the interposition of his friend Pericles, was a warning of his danger had he exposed this doctrine in public: He was, therefore, compelled to communicate it privately to his disciples under the seal of mystery, whilst he flattered the prejudices of his countrymen, by maintaining, in public, the immobility of the Earth. The motion of the planets round the Sun seems to have suggested to him that the comets were not fleeting meteors, but bodies resembling the planets, and circulating round the central luminary.

Ptolomy, who flourished 130 years, A. C., supposed that the Earth was fixed, and immovable in the centre of the Universe, and that the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn revolved round it, in the order they are mentioned. Above these were the firmament of the fixed Stars, the Chrystalline Orbs, the Primum Mobile, and, last of all, the Cœlum Empyrium, or Heaven of Heavens. All these vast orbs were imagined to move round the Earth once in 24 hours, and also in certain stated or periodical times, agreeable to the annual changes and appearances; every star was *supposed to* be fixed in a solid transparent

sphere, like chrystal, and to account for their different motions he was obliged to conceive a number of circles called eccentrics and epicicles, which crossed and intersected each other in various directions, and, if any new motion was discovered, a new heaven of chrystals was formed to account for it, so that, as Fontinelle observes, heavens of chrystals cost him nothing, and he multiplied them without end to answer every purpose.

Copernicus, in the 16th century, adopted the Pythagorean system, and, taking the planets out of their chrystalline orbs, sent the Earth to revolve round the Sun with the other planets.

Rennes de Cartes, a French philosopher, who was born in the year 1596, was the author of a new system, which has been so highly extolled, and considered, by many, as the most extensive and exquisite in its contrivance of any that had yet been imagined.

Calculating on the omnipotence of the Almighty, after explaining the formation of matter, and its division into different elements, he proceeds to show that the Universe might have assumed its present form, and may be, for ever, preserved, by mechanical principles.

To account for the motion of the celestial bodies, the Sun is supposed to be placed in the centre of a vast whirlpool of subtle matter, which extends to the utmost limits of the system; and the planets, being plunged into such parts of this vortex as are equal in density with

themselves, are continually dragged along with it, and carried round their several orbits by its constant circulation. Those planets, which have satellites, are, likewise, the centres of other small whirlpools, which swim in the great one; and the bodies, that are placed in them, are driven round their primaries in the same manner as their primaries are driven round the Sun.

Now, as the Sun turns upon its axis the same way that the planets move round him, and the planets turn round their axes the same way as their satellites move round them, it was imagined that, if the whole planetary region was filled with a fluid matter, like that before-mentioned, the Sun and planets, by a constant rapid rotation on their axes would communicate a circular motion to every part of this medium, and, by that motion, drag along the bodies, that swim in it, and give them the same circumvolution.

I shall now give some explanation of the system of that celebrated character, Sir Isaac Newton, who brought the system of Pythagoras and Copernicus to the greatest perfection of which it was susceptible. It will, therefore, naturally be concluded that it embraces the doctrine, that the Sun is the centre of our system, and that all the planets revolve round it in different periods of time, constituting their years, and that they likewise revolve round their imaginary axes, in different periods, *constituting* their days.

The most distinguishing tenets of the Newtonian doctrine are those respecting the phenomenon of falling bodies, and the principles which produce the motions of the planets and retain them in their orbits.

His attention was drawn to the contemplation of this subject, by the circumstance of an apple falling, one day, from a tree, whilst he was sitting in an orchard in the country, where he had retired from Cambridge, in the year 1666, to avoid the plague, which raged, at that time with great violence.

He was led, by the above circumstance, to enquire into the cause of weight, with which philosophers have been so much embarrassed, as to consider it almost inexplicable. The result of his reflections was, that all bodies were found to fall to the earth in a direction tending to its centre, and that such was the case on whatever part of the surface of it the experiment was made.

He concluded farther, that, if a hole was bored through the centre of the earth, that the weight of a body, if placed at the centre, would be nothing, as the same principle would act upon it on both sides of the centre, and prevent its proceeding beyond it.

He likewise concluded that, although the velocity of a falling body increases as it approaches the surface of the earth, yet, on entering the hole, it would decrease as it should approach the centre, where it would stop and

remain at rest. This, he supposed, would be produced by an attractive force exerted between particles of matter, and that, as in its progress to the centre, the portion of the earth it would pass would naturally increase,—the attraction would likewise increase, in a like ratio, until it should arrive at the centre, beyond which it could not proceed, as the attraction of the particles of matter on the opposite side of the centre would be completely counterbalanced by that of those on the side at which the body entered.

This principle is supposed to decrease in power as the squares of the distances increase from the surface of the earth, where it is supposed to act with the greatest power. It is evident, therefore, that this power is supposed to be subject to diminution either in descending or ascending from the surface of the earth: the orbicular motions of the different bodies (constituting one solar system) round the sun have been accounted for by this principle, and may be explained in the following manner:—

It is supposed that the bodies, constituting our solar system, may have been projected with great force in a rectilinear direction, and that, as soon as they began to move, the Sun's attraction acted upon them and drew them towards it, and that, being acted upon by two forces, they neither proceeded directly forwards nor fell directly downwards, but kept a middle course, and moved round the Sun in curvilinear

orbits. These bodies are supposed, also, to have attractions towards each other, in proportion of the squares of their respective distances from each other, and the quantity of matter they respectively contain. It seems difficult, however, to reconcile the various situations of the different bodies, which constitute our solar system, as to one another, to the established laws of attraction, for how can we suppose it is susceptible of such modification, as to permit those bodies to retain equal velocities when nearest, as when they are at the greatest distances from each other.

Sir Isaac Newton likewise concluded, that the earth was that of an oblate sphere, and that this form had been acquired by a mechanical effect, arising from a centrifugal force supposed to be produced by its diurnal motion round its imaginary axis.

Motion might, as easily, have been produced by omnipotence, by a projectile force, as by any other principle, but to retain its effect unimpaired, it is necessary to suppose that it must always be kept up, and with increased power, so as to counteract the opposition of the dense atmosphere, through which the planets move: This, we must conclude, is not impossible to the Almighty,—but that the form of the earth should have been supposed an oblate sphere from the supposed operation of the mechanical principle above explained, and that in the face of actual admeasurements of a degree both in

France and England, is calculated to excite astonishment, as the knowledge of mechanics, and the circumstances attending this globe were, even at that period, by no means calculated to render the existence of such a mechanical principle reasonable;* this may show

* By the prejudices of education our Astronomers have been thus misled; those prejudices which, from infancy, attach, without reflection, to fashionable errors that lead to fortune, and which engage us to reject solitary truths that lead to none. They have been seduced by the reputation of Newton, which has been objected to myself, and Newton had himself been seduced, as usually happens, by his own system. That sublime Geometrician proceeded on the supposition, that the centrifugal force, which he applied to the motion of the stars, had flattened the poles of the earth, by acting upon its equator. *Norwood*, a Mathematician of England, having found, by measuring the meridian from London to York, the terrestrial degree to be eight fathom greater than that which *Cassini* had measured in France.—"*Newton*," says *Voltaire*, "ascribed this small excess of eight fathom in a degree to the figure of the earth, which he believed to be that of a spheroid, flattened towards the poles; and he concluded, that *Norwood*, having taken his meridian in a region to the northward of ours, must have found his degree to be greater than that of *Cassini*, as he supposed the course of the earth measured by *Norwood* to be the longer of the two." It is evident that the degree being greater, and the curve longer toward the north, *Newton* ought to have concluded that the earth was lengthened out at the poles; but he deduced the directly opposite conclusion, namely, that it was flattened there. The truth is, his system of the heavens, occupying all the faculties of his vast genius, prevented his detecting, on the earth, a geometrical inconsequence: he adopted, therefore, without examination, an experiment which he thought favourable to his system, not perceiving that it was diametrically opposite to him. Modern Astronomers have, in their turn, suffered themselves to be seduced by the reputation of *Newton*, and by a weakness so apt to warp the human mind—that of attempting to explain all the operations of nature by a single law. *Bouguer*

how the human mind has allowed itself to subscribe to a conclusion, which, the most superficial investigation would have proved so completely destitute of support.

If we are to exert our reasoning faculties upon any subject, the truth upon

himself, one of their co-operators, in his *Treatise on Navigation*, book v, chap. 5, sec. 2, page 435, says expressly, that "on this discovery of the flattening of the poles, the whole of Physics almost depends."—*De St. Pierre, Advert. to his Studies of Nature*, p. xiii.

According to *Bouguer*, a well-known academician, in his *Treatise on Navigation*, book iv. chap. 3, sec. 3.—"Refraction elevates the stars in appearance; and we are assured by an infinite number of certain observations, that, when they appear to us in the horizon, they are, in reality, 33 or 34 minutes under it."

"You see, in fact, at this part of his work a small table, in which he lays down the greatest refraction of the sun in the horizon, at 34 minutes, for all the climates of the globe.—But how came it to pass that Barents should have seen the sun above the horizon of Nova Zembla, on the 24th January, in the sign of Aquarius, at five degrees twenty-five minutes, whereas he ought to have been there in sixteen degrees twenty-seven minutes, in order to be perceived in the seventy-sixth degree of northern latitude, where Barents then was? The refaction of the sun then above the horizon was nearly two degrees and a half, that is, four times as great, nay, more than *Bouguer* supposes it to be, as he assigns only thirty-four minutes, or nearly, for every climate in general. *Barents*, in truth, was very much astonished to see the sun fifteen days sooner than he expected, and he could not be persuaded that it actually was only the 24th January, but by observing, that very night the conjunction of the moon and Jupiter, announced for the latitude of Venice at one hour after mindight, in the ephemeris of Joseph Sosia, and which took place that very night at Nova Zembla, at 6 of the clock of the morning, in the sign of Taurus; which gave him at once the longitude of his hut in Nova Zembla, and the certainty that it must be the 24th January."—*De Saint Pierre's explanation of the plates*, p. xxx-i.

which we cannot ascertain, ought we not to embrace that doctrine which is most strongly countenanced by, and most reasonably accounts for the production of the different phenomena of nature familiar to us ?

The phenomena of nature, familiar by daily observation, are very justly supposed to be produced by chemical agency, in fact the evidences are too conclusive to admit of a doubt upon the subject. It is equally evident that the grand agent which produces those phenomena is the caloric or heat, which prevails near the surface of our globe ; the cause, however, assigned for the production of this agent is scarcely calculated to produce conviction, for it does not appear reasonable to suppose that a calorific medium should only exist near our globe, and the other planets, so as to produce caloric, by being acted upon by the solar light, as we have no chemical analogy within the limited range of practical chemistry to build such a doctrine upon.

## SOURCE OF MATERIALITY.

It has been demonstrated that all nature has had its origin from, and is supported by, chemical action. This fact, which seems to afford such strong support to the following Theory, is adverted to by Mr. Murray, in his introduction to his Elements of Chemistry.

The principle productive of chemical pheno-

mena has been distinguished by the name of attraction, arising, no doubt, from the elections, apparently exhibited in various degrees, between particles of matter; if, however, we can arrive at some knowledge of the grand agent which first produced the chemical results which nature, in her wide domains, displays, to which its evident and acknowledged effects in the operations of nature, as well as analytical, as synthetical experiments, would seem to lead, we may probably be able to apply a term less at variance with the reasonable attributes of inanimate matter.

This agent, it would seem, from our intimate acquaintance with its effects, we cannot hesitate to recognise, as the expansive principle of caloric.

When, however, with our very limited knowledge beyond its effects in the operations of nature, we are inclined to enquire for the agency which produced the substances belonging to the mineral kingdom, which, chemistry demonstrates must have been the result of chemical combinations, we are compelled to confine ourselves to analogical reasoning from the known chemical operations of nature; in this enquiry we appear to lose sight of a circumstance which might give it a particular direction; this circumstance becomes discernible in the practical decomposition of bodies and the simultaneous production of fresh compounds; in these experiments it is almost need-

less to observe, that a much higher degree of caloric must be used than what prevails near our globe: this would seem to point out that, the original formation of such bodies may have required the operation of this agent in a like intensity. And, as water, even, is known to be the result of the chemical action of combustion, may we not reasonably conclude that all nature is the simultaneous result of the agency of caloric, but in a much higher degree of intensity than prevails near our globe?

Being, therefore, thus brought to suppose that this earth may be the result of the operation of caloric in a high degree of intensity, we are naturally led to the enquiry whence its operation could have disengaged the elements of which all materiality seems to consist, in different proportions, and degrees of affinity. In this reseach, let us reflect from what source we can obtain some of the same elements, which are discoverable in material bodies.

This enquiry leads us to look to the atmosphere as the source whence materiality may have been disengaged, elements having been detected, in either, common to both. The constituent parts of the atmosphere, as far as can be ascertained, by chemical analysis, are in the relative proportions as follows:—

| | | |
|---|---|---|
| Nitrogen Gas | 77. 5 by measure, | 75. 55 by weight |
| Oxygen Gas | 21. – | 23. 32 |
| Aqueous Vapour | 1. 42 | 1. 03 |
| Carbonic Acid Gas | 1. 08 | –. 10 |

Chemical analysis has detected the same elements in many different material bodies in their native states, as

Oxygen, in the different native Oxides, and Sulphates, and Water.

Oxygen and Nitrogen, in Nitre.

Carbonic Acid, combined with lime, in the different varieties of Lime-Stone, Marble, and Chalk.

There seems, therefore, every reason to conclude, that the atmosphere contains many more constituents, if indeed, not all that have contributed to the creation of all materiality, notwithstanding the experiments, to which it has been submitted, have only led to the discovery of those which have been stated. This inference seems strongly supported by the meteoric stones, and other substances, which have fallen out of the atmosphere upon the earth, in different parts of the world, the former of which, although falling in parts so distant from each other, as Benares in the East Indies, Yorkshire, Venice in Italy, and Bohemia, having strict relation to each other.

All having Pyrites—a coating of black oxyd of iron—and containing an alloy of iron and nickel—and the earths, which served them as a sort of connecting medium, corresponding in their nature, and nearly in their proportions.

Besides stones, other substances have been known to fall upon the earth, such as iron, mercury, sand, sulphur, and sulphureous rain.

May we not conclude, therefore, from the analogy of the laws of practical chemistry, that, the elements of which materiality consists, may have been disengaged from the atmosphere by the action of caloric, in a high state of intensity. Does not the formation of materiality refer us to the operation of a much greater intensity of caloric than prevails near our globe, when we reflect that similar bodies, even water, are not its result in the degree in which it now exists? The evident congeniality between the atmosphere and matter seems further evinced, when we consider that hydrogen gas must have been evolved and ignited, during the simultaneous creation of all matter, or water, which constitutes such a large portion of this terraqueous globe, could not have been a result, and that hydrogen exists in pit coal and sulphur, and may probably constitute their inflammable principle. In fact, almost the whole of the gealogical phenomena afford indisputable evidence, in the extensive existence of carbonates, coal, water, basaltes, and other bodies, that the original formation of materiality may have been the result of combustion: this will become a conclusion still more consistent with reason, when the following theory shall have been duly weighed.

## IGNITIBLE PRINCIPLE.

May not hydrogen be reasonably considered the only inflammable principle? We seem particularly led to this conclusion, by the circumstance that a body which is an oxide, but does not contain hydrogen, is not inflammable, whereas a body which contains hydrogen, is inflammable, and even if an inflammable body be added to one in which oxygen exists, and which was not before inflammable, that body immediately becomes so.

Sir H. Davy has submitted that as oxygen is the only elementary body attracted by the positive surface in the electric circuit, and that as all compound bodies that are attracted by this surface, contain a considerable portion of oxygen, and that as hydrogen is the only matter attracted by the negative surface, which can be considered as acting the opposite part to oxygen, whether the different inflammable bodies, which have been considered simple, may not contain this as a common element.

Nitre by itself is not inflammable, but when an inflammable substance, as sulphur, (which, it is stongly suspected, contains hydrogen,) is added, it becomes highly combustible, and when charcoal is added, this quality seems so much increased, as to dissipate the compound into a

gaseous state, with such rapidity as to produce a noise, by the action of the expansion against the opposing atmosphere. All vegetable matter may contain hydrogen. This seems suggested by the circumstance that vegetation is completely dependant upon the existence of moisture, and whereever moisture is, there is hydrogen as a constituent; if moisture, therefore, is so generally diffused through vegetable, and even animal productions, may not hydrogen form a constituent, and impart their inflammable quality. That sulphur contains hydrogen seems to be strongly indicated, as when any house is struck with lightning, a smell of sulphur invariably follows; in fact, may not the different liquid acids even contain it, imparting to them their liquidity; for a suspicion of moisture always attends combustion, and consequently of the existence of hydrogen as a constituent. It would appear that pit coal is a risidual carbonate, still containing a portion of the hydrogen of the combustible body; carbon is considered a result of combustion, probably arising from a partial combination of the hydrogen of the combustible body and the oxygen of the atmosphere; this combination may be progressively overcome, and its constituents contribute to the continuance of the combustion, until the body ceases to exist.

May not the application of caloric, in the act of exciting combustion in an inflammable body, at the same time lessen the affinity of its

constituents, as well as that of the atmosphere, so as to render the hydrogen of the former (its inflammable principle) ignitible, as also enable the oxygen of the latter to combine with the ignited hydrogen, and produce water, and support the combustion. There is a circumstance attendant upon combustion, which seems to favour this suggestion, that is, that a much greater body of vapour and smoke is given out than can be considered the result of the evaporation of the moisture evident in the body; may not, therefore, some portion of the moisture, evidently expanded during combustion, be the result of the combination of a portion of the hydrogen and oxygen during combustion, and which is progressively expanded.

A

# NEW THEORY

OF

# PHYSICAL ASTRONOMY,

*&c. &c. &c.*

IT is unquestionably evident that the Sun is the grand source, in the hands of the Almighty, of light and heat, although we have not, hitherto, been able to divine how these effects are produced; indeed, there is every reason to conclude that, whatever theories may be raised, upon analogy, to account for the latter, the former must ever remain hid from us.

Our reasoning on the laws of nature have been fraught with so much contradiction, that we can only make our judgments acquiesce by the general conclusion that, what we cannot

satisfactorily reconcile to ourselves, is immersed in the arcanum of the divine secrets; such must ever be the case, as to our being certain that any of our theories arrive at the truth, but our otherwise concluding so, however pious in the christian, is calculated to retard physical inquiry, as the rigid faith in existing doctrines to repress discovery.

In the early ages, the Sun was considered a ball of fire, and this opinion even prevailed in the time of, and was sanctioned by the celebrated Sir Isaac Newton, who considered that its heat, abating as the squares of the distance increase, remains at the distance of our globe of the temperature of our atmosphere. He even calculated the time that a body of its size and heat would take to cool; when telescopic observations, however, were made, it was found that the appearance of its surface by no means countenanced this doctrine. The veil of mystery, however, still remains so impenetrable, that even Dr. Herschell could not entirely divest himself of a similar idea, for although he considered and endeavoured to establish the doctrine that the solid body of the Sun might be inhabited, yet, on the authority of Dr. Brewster's Encyclopædia, p. 616, 617, and which is unquestionable, it seems he was of opinion that the heat and light are generated in the outer of two strata of clouds, which he supposed surrounds the solid body, whilst the interor stratum defends the inhabitants of the Sun

from the fiery blaze of the stupendous furnace by which they are enclosed. The Doctor, however, seems to have entertained rather confused ideas upon this subject, for in a paper which he read before the Royal Society, 18th December, 1794, he says, "that the Sun has a very extensive atmosphere, cannot be doubted, and that this atmosphere consists of various elastic fluids that are more or less lucid and transparent, and of which the lucid one is that which furnishes us with light, seems also to be fully established by all the phenomena of its spots, of the faculæ, and of the lucid surface itself;" but he does not say one word about the solar heat being generated there. Upon this subject, however, he says, in the same paper, "it may not be amiss to remove a certain difficulty which arises from the effect of the Sun's rays upon our globe. The heat which is here, at the distance of 95 millions of miles, produced by these rays, is so considerable, that it may be objected that the surface of the globe of the Sun itself, must be scorched up beyond all conception. This may be very substantially answered by many proofs drawn from natural philosophy, which show that heat is produced by the Sun's rays *only when they act upon a calorific medium;* they are the cause of the production of heat, by uniting with the matter of fire which is contained in the substances that are heated." A little further on he continues, "on the tops of mountains of a sufficient height, at

an altitude where clouds can very seldom reach, to shelter them from the direct rays of the Sun, we always find regions of ice and snow. Now, if the solar rays themselves conveyed all the heat we find on this globe, it ought to be hottest where their course is least interrupted.—Again, our Aeronauts all confirm the coldness of the upper regions of the atmosphere; and since therefore, even on our earth the heat of any situation depends upon the aptness of the medium to yield to the impression of the solar rays, we have only to admit that on the Sun itself, the elastic fluids composing its atmosphere and the matter on its surface, are of such a nature as not to be capable of any excessive affection from its own rays.

"Another well-known fact is, that the solar rays of the largest lens, thrown into the air,* will occasion no sensible heat in the place where it has been kept for a considerable time, *although its power of exciting combustion when proper bodies are exposed, should be sufficient to use the most refractory substances.*" It may, therefore, be seen, that Dr. Herschell considered the Sun to be inhabitable.

In Dr. Brewster's Encyclopædia, p. 617, a new theory is proposed, as follows—"The opacity of the interior globe of the Sun is no reason why it may not act a part in the production or preservation of the solar heat, on the contrary, it appears highly probable and con-

* Presented to the Sun.

sistent with other discoveries, that the dark solid nucleus of the Sun is the magazine from which its heat is discharged, while the luminous or phosphorescent mantle, which that heat freely pervades, is the region where its light is generated. Dr. Herschell's own experiments assure us that invisible rays, which have the power of heating, and which are totally distinct from those which produce light, are actually emitted from the Sun; and that luminous rays, incapable of producing heat, are discharged from the same source. These facts, therefore, not only confirm the theory which we have stated, but receive in return from that theory the most satisfactory explanation. The invisible rays which pervade every part of the solar spectrum, formed by a prism; and which extend beyond its red extremity, are emitted from the opaque nucleus, and, therefore, excite no sensation of light on the human retina, while the coloured rays which form the spectrum itself are discharged from the luminous matter that encircles the solid nucleus, and are, therefore, endowed with the property of illumination. Hence it is easy to assign the reason why the light and heat of the Sun are apparently always in a state of combination, and why the one emanation cannot be obtained without the other. The heat projected from the dark body, and the light emitted from the luminous atmosphere, are thrown off in lines diverging in every possible direction, so that

the two radiations must be uniformly intermingled, as in a stream flowing from two contiguous sources, the heat must always accompany its kindred element. That light and heat are two distinct substances, distinguished by different properties, is a proposition which seems to flow from the most recent experiments. We find the invisible heat of the Sun existing separately from its light, and possessing a degree of refrangibility less than the least refrangible rays of the prismatic spectrum. Light has likewise been found separate from heat; and though it may be imagined that this arises from the extreme attenuation of the light, yet, when the light of the moon is concentrated by powerful burning mirrors, we ought, certainly, to have expected that the heat, if any did exist, would be appreciable by delicate thermometers. Every attempt, however, to detect heat in the rays of the moon has completely failed; and we are, therefore, entitled to presume, that, a greater proportion of heat than of light has been absorbed by that luminary. If light and heat, then, be two different substances, endowed with different chemical and physical properties, is it not unphilosophical to suppose that they are emitted from the same source, when we have actually two different regions in the Sun, to which we can, with more propriety, refer their origin?"

"This opinion, which we proposed only as a conjecture, founded on the most probable ana-

logies, will receive considerable confirmation if we can adduce any strong analogical arguments against the supposition that the Sun is a habitable world; for, if the nucleus is not fitted for the reception of living beings, it is the more probable that it acts a capital part in the production or preservation of the solar heat. Some arguments have already been suggested relative to this point. We shall endeavour to illustrate two other considerations, which, we trust, will have some weight in favour of our opinion. Since those who considered the Sun as a habitable world, found this opinion upon analogical arguments, we are entitled to avail ourselves of all the assistance which can be drawn from the same source." —" If the Sun, then, be a great habitable planet, we may expect to find in it those points of resemblance to the other planets which are regarded as distinctive marks of a habitable world; and, if we shall find that any analogy which subsists with respect to all the other planets fails, when applied to the Sun, we are entitled to consider this difference as a proof that the Sun is not inhabited."

" In proceeding from the remotest of the planets to the centre of the system, we find that a general law prevails respecting the densities of the planets. These densities appear to increase as the planet is nearer the Sun. Thus we have for the density of the

Georgium Sidus - - $\frac{20}{100}$

| | |
|---|---|
| Saturn - - - - | $\frac{13}{32}$ |
| Jupiter - - - - - | $1\frac{1}{24}$ |
| Mars - - - - - | $3\frac{2}{7}$ |
| Earth - - - - - | $4\frac{1}{2}$ |
| Venus - - - - - | $5\frac{11}{15}$ |
| Mercury - - - - | $9\frac{1}{6}$ |

with a single exception in the case of the Georgium Sidus, whose density is not yet accurately ascertained. The densities uniformly increase according as the habitable world approaches to the centre of light and heat. We should therefore have expected from analogy, that the habitable part of the Sun would have exceeded Mercury in density; because it is nearer than that planet to the source of light and heat.—This, however, is far from being the case; the density of the Sun is only 1, 2-15, a little greater than the density of water: Here, then, we have a complete breach in the analogy which we anticipated; and it is no objection to this argument to say, that the situation of the Sun, in the centre of the system, may exempt it from the general law of density; because this is a virtual admission that the analogical reasoning on which Dr. Herschell's opinion is founded, cannot be fairly applied in such a case."

I shall only make one observation upon the foregoing speculations, as to the Sun being habitable or otherwise, which is, that all analogy between the planets and the Sun seems to fail

to the ground, when we reflect that the Sun is the source of the light which illuminates all the planets, and comets; and more particularly if the theory of the nature of the Stars proposed in the following pages can be subscribed to.

If we are to form any conclusion upon this subject, let it be that to which all the phenomena of nature directly point to. We know that the heat decreases in very quick progression, as the distance from our globe increases; this being the case, what intensity of cold must not prevail at the distance of the Sun? I cannot refrain from imagining that of even congealing the very atmosphere itself. May not the Sun, therefore, be the atmosphere in a state of congelation, and may not its atmosphere be that part of the atmosphere, surrounding the complete congelation, in a state of partial congelation, or condensation, similar to the moisture in our atmosphere when condensed into clouds and vapour: May not that atmosphere likewise have a similar refractive quality as our atmosphere when condensed, and refract the rays of light generated within it?

These ideas seem to be countenanced by the discoveries of Dr. Long, and the Reverend Dr. Wollaston, and particularly by the simile made use of by the latter; the more so as the result of his observations are not brought forward in support of any hypothesis or theory, but in explanation of the general phenomena of the

solar spots. * "When Dr. Long was examining the Sun's image, received upon a sheet of white paper, he observed a large round spot divide itself into two, which receded from each other with immense rapidity. The Rev. Dr. Wollaston perceived a phenomenon of a similar kind, with a twelve-inch reflector: The spot burst in pieces when he was observing it, like a *piece of ice*, which, thrown upon a frozen pond, breaks in pieces, and slides in various directions."

We have all observed the very great brilliancy of the Sun's rays, when reflected upon a piece of ice, when, therefore, material congelation can produce such brilliancy, what must be the brilliant effect of the elastic vapours of the atmosphere when arrested by congelation?

I have only further to observe, that, if the ideas advanced in the following pages, as to the manner in which light is emitted from the Sun, can be considered as reasonable, it would appear that the light must be generated within its atmosphere, so as, in passing through it as a dense medium, to be refracted, in cones, to the foci of the various lenses, it may constitute.

* Brewster's Encyclopædia.

## ANALOGY OF THE CONVEX LENS

I shall ground my theory of Physical Astronomy, in the same manner as that of Optics, as regards Vision, upon Analogy.

Take a convex lens and present it to the direct light from the Sun, and, with your other hand, hold a piece of paper behind it, and draw it back until you see a very shining spot upon it, making it as small as you possibly can, by drawing the paper back, and you will find, if you hold the lens and paper very steady, that the paper will be burnt in that spot, in a very short time: The same effect will be produced upon any other substance having any combustibility in its nature, and, if the power of the lens be great, that of fusing almost the most refractory subtances, whilst the lens itself acquires no sensible heat.*

* See part of Dr. Herschell's paper, before alluded to, p. 26.

## PRIMEVAL IGNITION AND COMBUSTION.

Light having been created first, agreeable to holy writ,* and the Sun's disc, having been proved by Dr. Herschell, to be visibly convex,† may it not be deemed a reasonable conclusion that the atmosphere of the Sun may constitute transparent convex lenses, and that the light, generated within this atmosphere, may, in passing through it, be refracted in cones, to the foci

* And God said, let there be light: and there was light.
And God saw the light, that *it was* good: and God divided the light from the darkness.
And God called the light, day; and the darkness he called night. And the evening and the morning were the first day.
*Genesis, chp.* 1, *v.* 3, 4, 5.

† "In confirmation of those appearances, I carefully remarked, that the disc of the Sun was visibly convex; and the reason of my attention to this particular, was my being already long acquainted with a certain optical deception that takes place now and then when we view the moon, which is, that all the elevated spots on its surface will seem to be cavities, and all cavities will assume the shape of mountains. But then, at the same time, the moon, instead of having the convex appearance of a globe, will seem to be a large concave portion of a hollow sphere. As soon as, by the force of imagination, you drive away the fallacious appearance of a concave moon, you restore the mountains to their protuberance, and sink the cavities again below the level of the surface. Now, when I saw the spot lower than the shining matter of the Sun, and an extended plain, also depressed with shelving sides rising up to the level, I also found that the Sun was convex, and appeared in its natural globular state."—*Dr. Herschell's paper.*

of their respective lenses, in every direction around it, and in this case, agreeable to my analogy, may not those cones of rays of light, acquire heat, progressively as they approach their points of concentration (or foci), until it amounts to the highest possible state of ignition?

Light being proved to be a material substance, from its various phenomena, and as compression * may produce not only heat, but combustion in any combustible body; it may be reasonably deduced that the rays of light, acting upon each other with great velocity, under the compression, it is evident they must be subject to, near, and at their points of concentration, may be heated to the highest state of ignition?

If the above can be supposed reasonable, which will be made much more apparent in the sequel, what must have been the effects produced by this ignition upon the chaos (as it has been denominated) which filled the endless expanse of the Universe?

I conceive that the rastra of light, which are now directed to, and illuminate and warm the different planets which compose our solar system, were refracted in cones, at the first creation of light, proceeding on to their points of concentration, or the foci of their respective

* This idea has been suggested by the effects produced by the metallic tube, the analogy of which may be strengthened when we come to the explanation of lightning and meteors.

lenses, but different from those which still exist in having revolutionary motions round the Sun.

In the first chapter of Genesis, verses 1 and 2, it is written—

"In the beginning God created the heaven and the earth.

"And the earth was without form and void: and darkness *was* upon the face of the deep: and the Spirit of God moved upon the face of of the waters."

And after light had been created as mentioned in the 3d, 4th, and 5th verses, already quoted, it is written in verses 6th, 7th, 8th, and 9th—

"And God said, let there be a firmament in the midst of the waters, and let it divide the waters from the waters.

"And God made the firmament, and divided the waters which *were* under the firmament from the waters which *were* above the firmament: and it was so.

"And God called the firmament Heaven. And the evening and the morning were the second day.

"And God said, let the waters under the heaven be gathered together unto one place, and let the dry *land* appear: and it was so."

If, therefore, we are told that, in the beginning and before light was created, the earth was without form and void,* and that after light

* May not this convey the idea that, as its elements existed in the atmosphere universally diffused, without any *determinate* form, it is spoken of as existent but without *form and* void.

was created, the different other parts of the creation were evolved in the order in which it is reasonable to conceive, from their nature, they would have been created by the agency of caloric or heat, is it not reasonable to conceive that all these wonders might have been the result of the inconceivable heat which the cones must have possessed at and near these points of concentration ?

Might not the first action of the high state of ignition at the points of concentration of those cones which had revolutionary motions round the Sun, after having decomposed the chemical composition of the atmosphere, and, consequently, rendered it incapable of retaining all the elements it before held in imperceptible solution, have formed water or moisture by the combustion of the disengaged hydrogen and oxygen gases, and, having immediately afterwards evaporated it, formed a firmament by thus dividing the waters which were under the firmament from the waters which were above the firmament.

It appears a reasonable conclusion, from being explained as the first results after the creation of light, (with the existence of which our experience teaches us to couple heat) and from the manner in which it is explained, coupled with the division of water, that by the word firmament, is meant the rarified part produced by the action of the ignition. There

seems, in fact, no ground left for doubt, for it is expressly stated, that God made a firmament, and, *thereby*, (it would seem is meant) divided the waters which were under the firmament from the waters which were above the firmament.

At the same time that the processes of forming water, and its partial evaporation were going on, might not the other disengaged chemical elements, by their elective affinities for each other, have formed the different fixed bodies, which we find composing part of our terraqueous globe? may not the sea be the superabundant water which could not be evaporated by the prevailing heat? This seems evidenced in a most remarkable manner, by the different salts which sea water holds in solution, for I consider it reasonable to conclude that the water, whilst it was forming, might have some of the different salts, which were forming at the same time, dissolved in it;* this seems further evidenced by the well-known fact, that fresh water has its origin from evaporation, or more correctly, distillation. Does it not, therefore, become a reasonable conclusion that only sea-water was created in the beginning, and that

* "And God said, let the waters under the heaven be gathered together into one place, and let the dry *land* appear: and it was so.

"And God called the dry *land* earth; *and the gathering together of the waters called he seas:* and God saw that *it* was good.

*Genesis, chap.* 1, *vs.* 9 *and* 10.

fresh water had its origin from the recondensation of the water, which was evaporated during the formation of sea-water, in the form of rain.

I have explained the above effects as being confined to the cones which revolved round the Sun. I shall now endeavour to explain why they have been produced by them only, and not also by those which were fixed and had no motion.

In the first place, it is necessary to point out the fixed cones, or those which had and have no revolving motion. These are evidenced by the fixed stars, which are their points of concentration. The ignition existing at and near the points of concentration, render them visible to us, and the ignited rays crossing at those points, occasion the twinkling of the stars, which is the distinction, to the naked eye, between them and the planets.

What might have produced a different result from the effects of those cones which had motion, from that of those which were fixed and had no motion, I consider might have been that motion; for, I conceive that after the ignition had disengaged the elements, and whilst they were forming, by their elective affinities, compound gaseous bodies; (pl. 1, a.) the cones moved on, and left spaces of cool atmosphere, through which they were forced back into the rarified parts, by the dense atmosphere rushing in to recover the equilibrium. This cool atmosphere may have had the effect of condens-

ing those compound gases, whilst passing through it, into fixed bodies: those fixed bodies, I conceive, would be drove off from the points of ignition, and, as the dense atmosphere, constantly rushing in, would keep them in the cones, would, consequently, be drove up the cones.—(pl. 1, b.)

This process must have proceeded very rapidly, and soon filled the cones with bodies, and water; (pl. 1, c.) when this had taken place, the rays of light having been intercepted from passing to the points of concentration, the ignition must have ceased. This process might have proceeded in the respective cones, with a rapidity proportioned to the velocities of their motions.*

Might not those bodies and water have been kept in the cones, and formed into a sphere in each cone by the surrounding dense atmosphere pressing in to recover the equilibrium; might not the dense atmosphere behind those spheres, (d. 1,) being left without control (the ca-

* "And God saw every thing that he had made, and, behold, *it was* very good. And the evening and the morning were the sixth day."

*Genesis, chap.* 1, *v.* 31.

"Thus the heavens and the earth were finished, and all the host of them.

"And on the seventh day God ended his work which he had made; and he rested on the seventh day from all his works which he had made."

*Genesis, chap.* 2, *vs.* 1 *and* 2.

It seems doubtful whether all the bodies which fill the endless expanse of the universe, are not implied in the above passages, as having been created in six days.

loric behind having ceased, and an intense rarifying power still continuing to act on their sides, presented to the Sun, (d. 2,) and preventing the exterior dense atmosphere, on their sides turned to the Sun, from rushing in with sufficient power to counterbalance it,) have pressed them towards the Sun until they had arrived at those parts of their cones, where the elastic spring of repulsion (if I may use the expression), of the expanded atmosphere, near their surfaces, presented to the Sun, was able to counteract the pressure of the dense atmosphere behind them; those spheres therefore, I conceive, may have become stationary at those parts of their cones. (pl. 1, e.)

The cones which had no motion, produced no bodies, because the processes of expansion and decomposition were constantly going on in the same place, consequently neither time nor space were allowed for the compound gaseous bodies to be condensed into fixed bodies, before they were pressed back again and underwent re-expansion.— (pl. 1, f.)

To the non-chemical reader, it may appear very unreasonable that water should have been the product of heat, or rather ignition, but to the chemist it is only necessary to observe, that the same ignition, which, in its course decomposed the atmosphere, and disengaged its elements, and enabled part of them to exert their elective affinities for each other, and form the fixed bodies of which part of our

globe consists, might have inflamed part of the disengaged hydrogen gas, and by the combination of part of the disengaged oxygen gas, have formed water and sea-water, as has been already explained. One of those bodies, so created, was our terraqueous globe.

There is a circumstance, well-known to chemists, which corroborates the foregoing doctrine, in the very strongest manner, which is, that the chemical decomposition of all fixed bodies requires much greater heat than the solar heat which prevails near our globe. Does it not, therefore, become a reasonable conclusion, that this globe, or the matter, of which it consists, must have been created such chemical compounds by much greater heat also?

There is another most remarkable evidence in favour of this theory, which, although, no doubt, observed by every person, has not, hitherto, been comprehended. At the meridian of a very calm and hot day, a most elastic fluid will be seen springing up to the height of about a foot from the ground, or roof of a house. I have frequently been surprised with this appearance, before I discovered this theory, the cause of which I could not imagine, for I have always been satisfied that it was not the evaporation of moisture, as no rain had fallen for a considerable time before. The discovery of this theory, however, dispelled the mystery in which this phenomenon was enveloped, and elucidated that it was produced by the repulsion of the

PLATE I.

dense atmosphere, which is constantly rushing in upon the surface of the earth to recover the equilibrium, in a greatly increased state of expansion, by the accumulated heat of the ground or roof; this repulsion of expansion renders the effect visible.

It was this agency which, at its first creation, made, and has, ever since, kept this globe of a spherical form, and which brought it to, and has ever since retained it in its present situation: it likewise produces the phenomena of falling bodies, known by the name of gravitation, and the convexity of the sea, and of all other portions of water, (however small) upon the surface of our globe.

## CONES OF LIGHT NOT OF GREATER DIAMETER THAN THE PLANETS IN THEM.

The cone of rays of light (by which the earth and the other planets have been created, and have been and are enlightened) are nearly of the same diameter with the respective bodies in them, or, at least, they are not larger, for we do not see a ray of light escape on either side, unless, sometimes, when we see the phenomenon called the Aurora Borealis

Was the cone of rays of light of larger diameter than the earth? I conceive that a fringe of rays would surround it at night, and have a very brilliant appearance in the otherwise prevailing darkness, no doubt the same as that produced by those sheets of rays of light, which pass towards the north and south poles in the Spring and Autumn, which are called the Aurora Borealis.* Did the rays given out by the Sun pervade generally throughout the expanse of the universe, or, even only beyond the space occupied by the earth, we should have no night;

* I am decidedly of opinion, that this phenomenon is produced by sheets of light passing the margin of the earth, which may not be of equal diameter with the cone, at those parts which may be presented to the Sun at those periods, and that the colours are produced by refraction.

for it is evident, from the brilliancy of the tails of Comets, (which may be produced by part of the rays of their cones, which may be of greater diameter than their bodies, passing them) that such would be the effect.

In further evidence, let us observe the rising and the setting of the Sun, and we shall see that, in the former case, there is not a ray of light, direct from the Sun, to be seen until it begins to appear above our sensible horizon, and, in the latter, when the Sun is descending below it, that the parting ray will dart across us, and that, afterwards, not another will be visible. It may be asked, if rays of light do not pass the margin of the earth, after the Sun has descended below our horizon, why do we not immediately see the stars? In answer, I have to observe, that light is reflected from all bodies with plain surfaces, in an angle equal to that of its incidence. If, however, the body has a convex surface, as the earth, the rays are reflected in a wider angle than that of incidence, in proportion to the convexity of the surface upon which they impinge; the reason, therefore, we do not see the stars immediately, is because the direct light which impinges upon the earth is reflected from it in the angle influenced by that of incidence, and the convexity of its surface: this reflected light,* therefore,

* Might not this reflected light from the earth constitute what has been called the zodaical light?

intervening between our eyes and the stars, in and near the horizon, eclipses them; but as we recede from this reflected light, and its angle of reflection progressively ceases to intervene between us and them, they gradually become visible.

Another reason why I cannot think that the cone of rays of light is, generally, of larger diameter than the earth, or that light pervades generally through the endless expanse of the universe, is because, was either the case, the stars beyond the diameter of our globe would be equally eclipsed from us during the night, as they are during the day; it is evident such an effect would ensue, when we reflect that the reflection of the light, which illuminates the earth, after the Sun has set, has the same effect.

It may be objected that, as the rays, at night, would not act directly upon us, they would not be so powerful as to eclipse that reflected from the stars: this, without due consideration, might appear plausible, but how futile will it not appear when we reflect, that the same effect is produced by even the reflected light from our globe, after the Sun has descended below our sensible horizon, and that that reflected light even does not act directly upon us, but only intervenes between our eyes and the stars, in nearly the same manner in which any direct rays of light, which might pass the margin of the earth, would.

In order to ascertain how this effect is produced, we have only to reflect that, if we look into a deep well, and there should be a star perpendicular to it, we should be able to see it very distinctly, although it should not be discernible, if we look directly towards its situation. This shows that, the rays of light, although reflected first from the star into the water, (where they produce its image) and afterwards through the water to tho eye, are capable of making the star visible, yet, that the rays reflected from the star directly to the eye, are incapable of producing the same effect: This leads us to inquire what can occasion this discordance. The circumstance which is calculated to clear up the mystery, seems to be that the eye, whilst directed to the star, has, at the same time, a great body of rays of light intervening between them, whereas, when looking into the well, a very trifling quantity of rays intervene, and none of equal brilliancy proceed with those, secondarily, reflected from the water to the eye. It seems evident, the refore, that this discordance is produced by a greater or less body of light intervening between the object and the eye.

There is no doubt, however, that the propinquity of this reflected light, or even of direct light passing between us and the stars, increases their effect, for we can distinctly see stars through the tails of comets.

It may be asked, if the direct rays of light

from the Sun do not extend beyond the space occupied by the earth, how can the beautiful skies be accounted for? I answer, very easily, for we see those beautiful skies only of mornings before the Sun has risen above the horizon, and shed his direct beams upon them, and of evenings, after he has descended below our horizon, and consequently withdrawn them.—These beautiful skies, therefore, it would seem, are produced by reflected light, and not by direct light; for if this was not the case, we ought to see the same effect produced during the day, when the cause is in constant operation.

I have, therefore, no hesitation in saying that I think the general expanse of the universe is equally dark by day as it appears to us by night, and that we are only impressed with a contrary idea, in consequence of the direct and reflected light rendering it imperceptible.

An opinion has been advanced, that the rays of the Sun are given out parallel to each other, and in support of it, it has been advanced that, was this not the case, the shadows of objects upon our earth would not be equally broad at their extremities as at the objects: To render this doubtful, it is only necessary to mention, that, agreeable to the laws of the reflection of light, it is not reasonable to suppose they can be given out parallel, unless we suppose the Sun to be flat: if, however, we suppose the Sun to be spherical, of which there

is sufficient evidence, the only other manner, excepting that contended for in this theory, in which it is at all reasonable to suppose a spherical body can give out its rays, is by individual rays, each perpendicular to its own base.

The heat which prevails near our Globe, and its rapid decrease as the distance from it increases, seems to afford one of the strongest evidences that the rays of light are refracted to it in a cone. The comparative trifling heat, likewise, which prevails at the immense distance of from 93 to 96 millions of miles from the Sun, seems to prove, when we reflect on the intense heat produced by a small convex lens, (the analogy with which I set out) that those rays must converge at a very trifling angle indeed: this angle, in fact, is so trifling, as to produce no sensible difference between the breadth of the shadows of the largest objects upon our Globe, at their extremities, and at the objects.

Æronauts, and travellers who have visited mountainous countries, have invariably reported that they found the cold increase progressively as they ascended,* the latter always experienc-

* The Mathematicians sent out by the King of France to South America, to make observations on the figure of the earth, reported that, they found the cold on Pinchincha extremely intense, and that though the smallest crevice visible in their hut was stopped, the wind was so piercing that it penetrated through, and though the hut was small, crowded with inhabitants, and had several lamps continually burning, the cold was so great that every person was obliged to

ed, at the same time, a difficulty of breathing, sickness of stomach, vomiting, (even blood) with giddiness of head, and at certain heights, (varying on different places, under the influence of local circumstances,) found regions of everlasting ice and snow, and that in the midst of the torrid zone, whilst the heat in the champaign country was excessive. This seems to contradict this theory, for no doubt, the increased cold experienced in proportion to the distance from the curvilineal surface of the earth, is occasioned by the greater progressive distance from the point of concentration.

An objection has been started against this theory, on account of the heat decreasing so quickly as we ascend from the surface of the earth: this, however, instead of constituting an objection, is calculated to confirm it, for this earth being brought by the dense atmosphere behind it, to that part of the cone where the rarefaction near it, acting upon the more distant dense atmosphere on the side turned to the Sun, is capable of checking the earth, and the

save a chafing dish of coals. By the severity of the cold their feet were swelled, and grew so tender that they could not walk without extreme pain; their hands also were covered with chilblains, and their lips so swelled and chopped, that every motion in speaking made them bleed.

M. Pouguer, who was engaged in the same expedition, says, "there is, in all this range of mountains, as far as I have travelled, a constant inferior boundary, beyond which the snow never melts; this boundary, in the midst of the torrid zone, I found to be 2434 fathoms above the level of the South Sea."

dense atmosphere behind it, there can be but very little of the heated part of the cone between the earth and the Sun, and in consequence, the heat must decrease very quickly as we ascend from its surface, the earth having been brought to that part of its cone where the heat begins to have a sensible effect.* This is too evident, from the whole theory, to require further explanation.

I shall now explain a phenomenon that will, probably, elucidate this part of my theory, more than anything I have yet advanced.

* I am of opinion that the expansive repulsion of the dense atmosphere, on the side turned to the Sun, by the caloric near the Earth's surface, is the agent in checking the earth and counteracting the dense atmosphere behind it, in strict analogy with the agency of steam; for was this not the case, would not the dense atmosphere force the earth on until the dense atmosphere became equally powerful on one side as another?

## THE TAILS OF COMETS.

The doctrine upon the appearances of the tails of Comets, has, hitherto, been indeterminate, some ascribing them to superabundant heat, or ignited particles, given out by them; this opinion had its origin from the tails assuming a much greater length and brilliancy as they approach the Sun, and are near their perihelion;* It is, however, at the same time acknowledged, that no satisfactory knowledge has been acquired on the subject.

I conceive that all the appearances of Comets may be satisfactorily explained, and accounted for by this theory.

To reconcile their appearances, therefore, to it, I have only to suppose that the cones of rays

* Tycho Brahe and Appian imagined that the tail was occasioned by the rays of the Sun, transmitted through the nucleus of the Comet, which they believed to be transparent like a lens. Kepler thought that it was the atmosphere of the Comet driven behind it by the impulsion of the solar rays. Des Cartes ascribed the phenomenon to the refraction of the nucleus. Sir Isaac Newton maintained that the tail of a Comet is a thin vapour ascending by means of the Sun's heat, as smoke does from the earth. Euler supposes that the tail is produced by the impulsion of the solar rays driving off the atmosphere of the Comets, and that the curvature of the tails is the combined effect of this impulsive force, and the gravitation of the atmospherical particles to the nucleus of the Comet. Dr. Hamilton supposes them to be streams of electric matter.

of light, which were instrumental in their creation, and in the production of all the phenomena attendant upon them, are of larger diameter than the bodies of the Comets: these bodies, therefore, being incapable of intercepting the whole of their cones of light, the outer rays, which are not intercepted, pass them to the rear, and form (what has, hitherto, been supposed to emanate from them), those lucid appearances, called their tails: this seems greatly strengthened by these appearances being always on the sides of the Comets that are turned from the Sun; that appearance on the side of Comets turned to the Sun, which has been called their heads, in consequence of being surrounded by a fringe of rays of light, may be explained very reasonably, as being produced partly by the reflection of a portion of the light impinging upon them, and partly by the light being generally spread out by the obstruction of the nucleus, in the same manner as water, under similar circumstances, when obstructed by a stone; the dark shadow immediately behind the nucleus, as well as the curvature of the tail, which will be treated of when I come to the consideration of the subject specially, seem to go hand in hand with the other evidences.

It may be objected that the rays, after passing the bodies of the Comets, would continue their course to concentration; this, however, even should they recover their original

course, we cannot be sensible of, for, after they proceed some distance behind the nucleus, they become equally invisible as they were before they were obstructed. It would, indeed, seem reasonable to suppose that the rays which pass the Comets are rendered visible in consequence of being turned out of their riginal course, and that they become again invisible, after having passed the nucleus some distance, in consequence of resuming that course.

Having brought forward so many evidences in favour of the idea, that the cone of light which enlightens the earth is not of greater diameter than the earth, which equally apply to the other plants, I shall now bring forward a phenomenon which will add strongly to the conclusion, that the light is given out, or rather refracted by the Sun's surface, or its atmosphere, in cones, in all directions around it, to points of concentration.

## THE STARS.

The fixed Stars are not considered to belong to our system, but in consequence of their immense distance, and the great splendour they possess, as well as the impossibility of ascertaining their forms and motions round their axes, (if they have any) are supposed to be so many suns, having their different systems revolving round them.

I am, however, led to think, they may be the concentrations of different cones of light refracted from the Sun, * and which have produced no opake bodies, as I have already explained, page 44.

It may be objected, that it does not appear from my reasoning, what occasions the irradiancy of Stars; this, however, I have no doubt, is produced by the rays of light (in a state of ignition,) crossing at their points of concentration, with their immence velocity of motion.† It may even be advanced, that the conclusion to be drawn from the analogy of the concentration of a cone of rays of

* May not this reasonably explain why Stars do not appear larger when the earth is in that part of its orbit which is nearest them, than when it is farthest from them; for, if Stars are concentrations of cones of light, they can occupy but points, (mathematically, no space at all,) and consequently can *only be points*, at what ever distance we may be from them?

† This motion has been calculated at the rate of 200,000 miles in the second of time.

light, by a convex lens, bears decidedly against me, as no radiance, nor even lucid appearance is thereby produced, not so much as even to mark the spot where it is concentrated, unless it is made to concentrate upon some object. All this I admit, but it is forgot that our horizon at night, is not illuminated in any other way than by the reflected light from the Stars and Planets, and that that reflected light only makes them visible to us,* and that although the Stars are equally luminous in the day time, around our horizon, they are rendered invisible to us, in consequence of being eclipsed by the more powerful light from the sun. If the Stars, therefore, are eclipsed from us by the glare of light from the Sun by day, is it not reasonable to suppose that the illumination of the concentration of a small cone of light, concentrated by a convex lens, will be also eclipsed?

It cannot argue against this theory, that we do not see the cones of light, (the concentrations of which constitute the fixed stars), for the cones which are directed to the Planets and Comets are invisible until they are obstructed by these bodies. These cones, therefore, are invisible, until the compression at their points of concentration has produced the ignition and consequent light which prevails there.

* If there were no Stars or Planets in our horizon at night, we should be enveloped in utter darkness; the same effect is produced at night when our horizon is obscured by *heavy clouds*.

## ANNUAL MOTION OF THE EARTH ROUND THE SUN.

Having explained how the earth was created and brought to its present situation, from which it cannot depart, owing to the pressure of the dense atmosphere on all sides, seeking to recover the equilibrium, I shall now endeavour to explain how its annual revolution round the Sun may be produced.

The only manner in which the revolution of the Earth round the Sun can be produced consistent with this theory, would seem to be by supposing that the cone of rays of light, in which it is, has a motion round the Sun, and completes its revolution in 365 days, 6 hours, &c. This being pre-supposed, it is evident that the Earth must make a revolution round the Sun in the same period, for, as the cone advances, the Earth is pressed on in the rarified part, (in which it is situated,) by the surrounding dense atmosphere pressing into the rarified part to recover the equillibrium of temparature. (See Plate II.)

The Newtonian doctrine contemplates that the different Planets have attractions to each other, in proportion to the squares of their distances from each other, and the quantity of matter they respectively contain: this, without

due reflection, may appear reasonable, when we observe that the Moon accompanies the Earth; but when we reflect that all particles of matter upon our Earth, however large they may be, and however great their attractions for each other, lose that power beyond a certain distance from each other, we shall be inclined to doubt that the planets can exert this power upon each other, at the immense distances at which they are: This, I think, we will doubt the more, when we find that they have the same velocities when nearest, as when they are at the greatest distances from each other. I am, therefore, of opinion, that the cones of light in which the different Planets are, have revolutions round the Sun in their respective periods, and that the Planets make their annual revolutions in the periods of their cones, in the same manner as the Earth, as has been explained.

If it can be conceded that the revolution of the Earth may be produced in the manner above explained, it would seem unreasonable to suppose that the Sun can be at a greater distance from it at one season than at another. May not, therefore, the apparent greater magnitude of the Sun in winter be the consequence of the refraction of the atmosphere, which must be much denser at that season than in summer? Might not this question be settled by observing whether the Moon is magnified in an equal degree at that season?

## DIURNAL MOTION OF THE EARTH ROUND ITS IMAGINARY AXIS.

I shall now endeavour to give an explanation how I conceive the diurnal rotation of the Earth may be produced.

As the Earth, in its annual course round the Sun, is constantly leaving the space it occupied before rarified, and the agency which produced that rarifaction and consequent expansive repulsion, progressively ceases to operate, the dense atmosphere, which was before expansed and pressed back, rushes in to recover the equillibrium, and by touching the edge of the Earth in that effort, produces its diurnal motion, and our days and night as is illustrated in Plate II., in which S is the Sun—E the Earth, and F the atmosphere, producing our diurnal motion.

This theory seems to derive considerable countenance, when we make a comparison between the times in which the different Planets perfom their respective diurnal revolutions, and their sizes thus—

| | | | | |
|---|---|---|---|---|
| Mercury's | Diameter is | 3,200 miles | his day | 24 hours |
| Venus | - - | 7,700 | - | 23 21 |
| Earth | - - | 7,900 | - - | 24 |
| Mars | - - | 4,200 | - | 24 39 |
| Jupiter | - - | 89,000 | - | 9 56 |
| Saturn | - - | 79,000 | - | 10 16 |
| Georgeum Sidus | | 35,000 | his day has not been ascertained. | |

This comparison, as to the smaller Planets, is not calculated to suggest the idea that the length of their days may be influenced by their respective sizes, but when we come to Jupiter and Saturn, and compare their respective sizes and length of days with each other, and with those of the smaller Planets, this conviction flashes upon the mind and leads us to enquire for the cause; very little reflection points out to us that the length of the lever, upon the end of which the dense atmosphere acts, will be in proportion to the size of the Planet, and that the power of the agent will be greater or less in proportion to the length of the lever; the power, therefore, of the dense atmosphere will be greater upon Jupiter and Saturn than upon the small Planets, and, consequently, make their days much shorter.

The diurnal motion of the Earth is supposed to explain the apparent motions of the Sun, Moon, &c. round it, more reasonably than that those bodies, many of which are so much larger that it, should revolve round it, and that as nature performs her work in the shortest and easiest manner, it is more reasonable to suppose that this appearance is produced by the Earth's revolving round its own axis, than that the Sun, Stars, &c. should be carried round it with such immense velocities, as it is evident from their great distances, the performance of their revolutions would require: the evident motions of the other planets, are the greatest

support to this doctrine, than has, hitherto, been advanced, although not sufficient to settle the point beyond dispute, for De Saint Piere has called this motion into question, by observing, that if the Earth has a diurnal motion, there must be a great difference in the space passed through by two cannon balls shot off at the same instant, the one towards the east, and the other towards the west, as the first goes along with the motion of the earth, and the second in the opposite direction. The Earth is supposed to move at the rate of sixteen thousand fathoms in a minute, and the motion of the balls from each other is at the rate of six thousand fathoms in the same time; he, therefore, concludes, that the point from which the balls were fired, ought to be twenty-two thousand fathoms before the ball fired to the west, and ten thousand fathoms before that fired to the east. This certainly would be the case, if there was no other agency to prevent this evident consequence, but it requires very little reflection to discover that there is a counteracting agency; this agency is the motion of the Earth, which communicates the propulsion of its motion to the gun, from which it is communicated to the ball fired to the east, whilst the same motion of the earth takes away the support from the gun, and consequently the propulsion from the ball fired to the west: this can be proved by the most familiar simile—let

Any one standing in such an inclining posture backwards, that the least exertion to his front would throw him off his balance, attempt to throw a stone with all his power to his front, and he will discover that the exertion will throw himself down, but will not propel the stone to any distance from him; the advantage of this simile lies in the conviction it will establish of the fact, that the firmer he stands, the greater distance will he be able to throw the stone.

I shall now bring forward an evidence which I have never seen advanced before, in favour of the diurnal revolution of the Earth, as explanatory of the apparent revolution of the Sun and other heavenly bodies round it, which may fix the question beyond an election of probabilities or choice of difficulties. If the Moon revolved round the Earth in twenty-four hours, her appearance, when full, would progressively change as she proceeded, for, as her situation, with respect to the Sun, alters so very little, in that space of time, as to produce no sensible effect, when she has risen 45 degrees above the horizon, she would have the appearance of a three-quarter Moon—when in our zenith, that of a half-moon—when 45 degrees to westward of our zenith, a quarter-moon, and when setting in the west, that of a new Moon; but were she in her zone at the time, we should not be able to see her at all, as the side which would be complete-

ly turned from the Sun, would be presented to us.* If this, therefore, is the fact, which every person's experience and observation will prove, what becomes of the inference attempted to be drawn by M. De Saint Piere?

* The author furnished a paper on this subject, for the Jamaica Journal, under the signiture of "Philo-Vitello," which was published in No. 50, under date 27th March, 1824.

## COMETS.

Having already treated of Comets, as regards their tails, I shall now endeavour to explain how, I conceive, their great velocities in their orbits, and the eliptical form of those orbits, may be produced.

I am of opinion that the Comets were created in the same manner as the planets, but their cones must have possessed high rarefaction for a great distance from their points of concentration; the dense atmosphere, therefore, on the rays of light being obstructed from passing, (the caloric behind having consequently ceased), rushing in, forced them upon the Sun with immense impetuosity, which, I conceive, must have accumulated as they proceeded to the point of counterpoise F, to that degree as to have forced them past that point, upon the Sun, as we see, and I shall endeavour to explain in the following passage, and illustrate by the annexed plate.

It is reasonable to suppose that the cones, by which the Comets were created, may have similar revolutionary motions round the Sun as the others which created the planets. I conceive, therefore, that whilst their cones are proceeding from 1 to 2, the Comets, at the same time that they are compelled, by the surrounding

dense atmosphere, to accompany their cones, are forced up their cones, by the dense atmosphere behind them, to a 2, and whilst they are proceeding from 2 to 3, the Comets are forced up to a 3, and so on, until their velocities are checked by the dense atmosphere on the side of the Sun, when they double the Sun as from a 7 to a 1. After they have doubled the Sun, as large bodies of rays of light pass them, and may proceed on to their points of concentration, and as a considerable degree of caloric may consequently prevail there, I conceive that the dense atmosphere on the side of the Sun, (in rushing in to recover the equilibrium), force them with great velocity upon the points of concentration: I conceive this velocity must have increased in a similar ratio as when they were forced upon the Sun by the same agency, and that they were propelled past the points of counterpoize E, as from a 1 to a 2, a 3, a 4, a 5, a 6, and so on, until the dense atmosphere, in overcoming their velocities, makes them complete the other ends of their eliptical orbits; those orbits, thus produced, are expressed by the line D D D D.

The point of counterpoize E, is that part of their cones where, if they had not acquired such immense impetus, they would have become stationary in the same manner as the planets.

It may be contended that my theory does not account for the greater extent and splendour of the tails of Comets as they approach

nearer the Sun, and the contrary as they recede from it. In reply, I have to observe, that I do not conceive their appearances are occasioned by any increase of heat as they approach, or decrease as they recede from the Sun, but by larger bodies of rays passing their bodies as they progressively get into wider parts of their cones, whilst advancing upon the Sun, and the contrary whilst receding from it. The appearance of their tails will also be altered considerably according as they may be situated with respect to the Earth, for, whilst they are situated without the Earth, as regards the Sun, less (if any) of their tails will be visible, as their bodies and the reflected light from them, (called their heads), will more or less intervene (pl. 3, o.); but as they approach and proceed within the situation of the Earth, as regards the Sun, more and more of their tails will be discernible, until they begin to double the Sun, when, (could they be seen at all for the greater brilliancy of the Sun), their tails would gradually disappear, and only leave their heads, which would have the same appearance as when they were approaching the Earth, with this difference only, that they would appear larger, as the parts of their cones in which they then would be, would be larger, This will be best understood by looking at plate 3, in which f is the earth; for it may be seen that, when the Comets are at d and o, they will not be discernible as Comets, but when they come to

a 3, (and probably before), they become visible, and more and more so as they proceed, until they are eclipsed by the effulgence of the Sun, as already explained.

The curvature of their tails may be produced by the dense atmosphere, through which they are moving, being able to oppose the progress of the tails, and, consequently, prevent them from keeping pace with the nucleus rectilinearly; this, however, it is easy to prove, for if this is the cause, the curve will be towards the side opposite to their course.

It may be contended, that as the temperature or caloric decreases so quickly as the distance from our Globe increases, the cones will at length lose all distinctive quality from the atmosphere of the general expanse of the Universe, long before they reach the Sun: This, however, I do not consider a reasonable conclusion, when we consider that even that reflected from the Moon, which, instead of being compressed, is spread out as the distance increases, agreeable to the angle of incidence and the convexity of the surface of the Moon, is found to have such influence upon our globe, and that at the distance of 237,000 miles. *

* "The Academy of Sciences formerly maintained that her light did not warm, after experiments made on her rays, and on the ball of a thermometer with a burning mirror. This question has, however, been completely refuted, first at Rome, and afterwards at Paris, by a very simple experiment. Some one took a fancy to expose a vessel full of water to

If, therefore, the reflected light from the Moon, in which no heat can be detected by the refraction of a burning mirror, still has such influence upon our Globe, what influence must not the direct light refracted by the Sun have!*

The fact, at all events, is proved by our seeing the Comets and their tails more distinct and luminous as they approach the Sun, for if the Comets were not then in their cones, we should not see them at all.

the light of the Moon, and to place one similar to it in the shade. The water in the first vessel was evaporated much sooner than that in the second."—*M. Bernardie De Saint Pierre Study*, ix. p. 488.

"The Moon produces thaw, dissolving all ices, and frosts by the humidity of her influence."—*Plin. Nat. Hist.*, b. ii, c. 101.

It is well known that clouds are dissipated by the influence of the Moon. This phenomenon I have witnessed myself: It has been termed by sailors "*the Moon eating up the clouds.*"

* May not the circumstance, that a burning mirror does not detect heat in the light reflected from the Moon, suggest that, as her light is reflected divergent in all directions under the influence of her convex surface, and consequently does not impinge upon the mirror perpendicularly or within that angle, that a mirror or lens cannot act upon it so as to produce calorie?

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## THE UNIVERSE, A CAMERA OBSCURA.

If this theory, evinced in so many ways, may be considered reasonable, as regards our Globe, it will hold equally good when applied to the other Planets.

It is well known, that rays of light are reflected from plane surfaces in exactly the same angle in which they impinge upon them. It has likewise been shown, in my theory of Refraction and Vision, that rays of light refracted by dense media having convex surfaces, diverge, after concentration, at exactly the same angle at which they were converged, until they arrive at the focal distance of the convexity by which they were refracted, and there deliver the image of the object which originally gave them out.

This would seem to lead to the conclusion, that the cones of rays of light refracted by the convex surface of the Sun, or its atmosphere, may, after concentration, diverge again from their points of concentration (or foci), at the same angle in which they are converged, until they arrive at the focal distance. At these focal distances may not the same negative effect exist and produce other Suns, and may they not deliver their images on each other reciprocally, agreeable to the effects produced by convex lenses in Camera Obscura?

These other Suns, it is reasonable to conclude, may refract their cones in the same manner as the first, some of which (having motion) may have produced planets and comets, and others (being fixed) may constitute stars. I think, therefore, it may reasonably be supposed that the endless expanse of the Universe may be filled with Suns, Worlds, Comets, and Stars, innumerable as space is infinite, (see plate 4). It would also seem reasonable to conclude, as the ignited rays open on both sides, after crossing at the point of their concentration, that both openings may be visible when viewed obliquely, and may constitute the double Stars which are frequently seen by Astronomers.

This theory seems to be strongly countenanced by an appearance which has always been observed by Æronauts; this appearance is that of the atmosphere, which becomes progressively darker as they ascend from the surface of the Earth, until it is completely black. I am of opinion, that the blue appearance otf he atmosphere, when viewed from the surface of the earth, may be occasioned by the reflected light from the earth enlightening it all around, and that the gradual change from that colour to black may be occasioned by those viewing it getting beyond the influence of this reflection, when they see it of its natural colour, which is (from the absence of light) black, (see plate 2). In evidence that this is the case, let us observe the effects produced of mornings and evenings

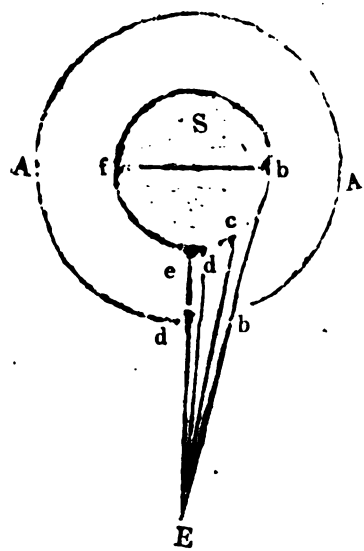
when the Sun is below the horizon, and we will see the atmosphere, immediately above where it is, very clear, without the smallest tinge of blue, but that, as the distance increases towards the opposite horizon, it gradually assumes a deeper tinge. It may be observable likewise, that, at any time, even when the Sun is in the zenith, the blue hue will be considerably lighter near the horizon than higher up; this, I think, may be produced by the greater body of reflected light which intervenes between the eye and the atmosphere near the horizon, than in any other direction.* May not also the progressive change of the colour of mountains, from black to the lightest blue, until they almost become entirely invisible, (agreeable to their distance), be reasonably explained in the same way, as the greater distance they may be at, the greater will be the body of light which will intervene between the eye and them?

It seems natural to conclude, that if the light is refracted by the surface of the Sun in cones, as is contended for in this theory, the rays that are at the margins of the cones will have less heat than those at the centres, and that they must possess power in proportion, as they are nearer the centres: that this is really the case, seems to be evidenced by Fabrici-

* I have, however, observed that this effect is not so visible over the sea as over the land, no doubt arising in consequence of water not being capable of reflecting the light so well as land.

us, who found that, when the Sun was in the horizon, and its brilliancy was impaired by thin clouds and vapours, he could make his observations, but that when its altitude became considerable, he was compelled to abandon them; and he informs us that his eye was so much affected by the impression of the solar light, that during the two following days he could not see objects with the same distinctness as before.

From a number of various experiments on the light of the Sun, made by the celebrated Bouguer, it appeared that the light was more intense at the centre of the Sun's disc than towards the limb, the very reverse of what should have been expected; for if S *(See Figure in page following)* be the Sun, f, b, c, d, e, the side that is turned to the Earth at E, then, if e d at the centre, and c b at the limb of the Sun are taken of such a magnitude, that they subtend equal angles to the eye at E, it is obvious that the light which comes from c b is so much more intense than that which comes from e d, as the surface c b exceeds e d. We can only account, therefore, for the superior intensity of the light at e d, as observed by Bouguer, by supposing the Sun to be surrounded with an atmosphere A A, the light which issues from c b having to traverse a longer trail of atmosphere than e d, the light b b will certainly be more enfeebled; but to render it less intense than




that which comes from e d would, we imagine, require an atmosphere much more dense than what can be supposed to surround the Sun."*

It would seem, from the whole of this theory, to be a reasonable conclusion, that what we seé of the Sun by no means constitutes the whole of its disc, but that it is merely the base of the cone of light in which our Earth is situated, or, in other words, the lens which refracts the cone: this will appear still more reasonable when we reflect upon the vast number of stars with which the firmament is studded all

* Brewster's Encyclopædia, page 612.

round our nightly hemisphere, and that they are all produced by the same hemisphere of the Sun, in which our Earth may be. We may, therefore, conclude, that the Sun is immensely larger than the part of his disc which we see can convey any idea of: the same reasoning why we do not see the light proceeding from the Sun in those cones, the concentrations of which constitute Stars, holds good as explanatory why we do not see a greater extent of the Sun's disc than what constitutes the lens which refracts the cone in which our earth is situated; for, as it is evident we do not see any of the other cones in which the planets and comets are situated (not even that of the Moon which is the nearest to us), until they are reflected from and pass them, we cannot see the surface of the Sun which refracts them; this, therefore, proves to us that we can see the lens and the light of the Sun *only* when the lens is directly opposite, and refracts the light directly to us.

An evident difference appears between refracted and reflected light, for the latter we can see, if situated ever so indirect to it, by means of rays reflected from rays; it is this which makes us sensible of the stars, and which supposes total darkness. This seems confirmed by the darkness consequent to our atmosphere being covered by thick clouds at night, which cut off this light.

The above considerations would seem to suggest that we cannot see any of the other Suns

throughout the endless expanse of the Universe, for, if we are not sensible of the cones of light which created and enlighten the other Planets forming our system, nor those others, the concentrations of which constitute Stars, nor even those parts of the surface of the Sun which refract them, because their light is not refracted directly to us, it seems a natural conclusion that we cannot be sensible of the other Suns.

A very striking coincidence may be obsered between this Theory of Physical Astronomy and my new Theory of Vision, which is that the same principle, which, by acting upon reflected light, produces Vision, by acting upon the direct light from the Sun produced all Materiality.

## OF THE MOON.

As my object is not to innovate upon the existing doctrine, where appearances are calculated to make it reasonable, (as is evidenced by the proof I have adduced of the diurnal motion of the Earth), I certainly should not touch upon the subject of Eclipses of the Moon, were not her appearance then so contrary to what might naturally be expected from light being intercepted from one body by the intervention of another, and the existence of the cause assigned for that appearance so very doubtful.

I shall now submit to the reader whether the incongruities of the Moon's appearance during an Eclipse, with the cause assigned for it, does not make this subject susceptible of further inquiry.

First, If the reader can satisfy himself, by the evidences adduced in this theory, coupled with his own observation and experience, that rays of light pass the Earth, during the time of an Eclipse, to be refracted by the Earth's atmosphere, I have no doubt that he will think with me, that this idea has very little reason on its side.

Secondly, As the utmost extent of the Earth's atmosphere is supposed not to extend beyond 50 miles, can it be supposed probable

that the few solitary rays (if we can suppose it possible, from appearances, that any do pass,*) which may pass the Earth, and be refracted by the Earth's atmosphere, can touch the surface of the Moon at the great distance of 237,000 miles and illuminate her surface?!!!

I am of opinion, that if rays of light really passed the Earth, indiscernibly, during an Eclipse, and were refracted by the atmosphere of the Earth, that refraction would operate in the same manner as that of convex lenses and of all dense transparent media having convex surfaces, as is explained in my new Theory of Refraction of Dense Media and Vision; they would, therefore, be refracted in a cone to the focus of the Earth's atmosphere: at this point they would cross† and diverge in the same an-

* It is scarcely possible to suppose that any rays of light pass the margin of the earth during an Eclipse, and be indiscernible, when we reflect what a beautiful effect they produce *when they really do pass* and constitute the Aurora Borealis.

† This seems corroborated in the most remarkable manner, by an appearance which always attends the Aurora Borealis, which is, that the rays all converge to a point in the zenith and form a corona.

"These northern lights begin with single bright pillars arising in the north, and almost at the same time in the north-east, which gradually increasing, comprehend a large space of the heavens, rush about from place to place with incredible velocity, and finally, almost cover the whole sky up to the *zenith*. *The streams are then seen meeting together in the zenith*, and produce an appearance as if a vast tent was expanded in the heavens, glittering with gold, rubies, and sapphires, a more beautiful spectacle cannot be painted."—*Gmelin's Account of this phenomenon in the north-eastern parts of Siberia.*

gle in which they were refracted, until they should arrive at the focal distance beyond it, they would, at this distance, have the power of illuminating if they should impinge upon any body, but I doubt very much whether they would retain that power beyond, for rays of light, refracted in the same manner in a camera obscura, lose their power beyond the focal distance from the point of their concentration.

| | |
|---|---|
| The diameter of the Earth is | 7916 miles. |
| The depth of its atmosphere doubled | 120 |
| Making together - - | 8036 miles. |

which constitute the focal distance of the convexity of the earth's atmosphere; if any rays of light,

In the spring of the year, and about the new Moon, this phenomenon generally appears so bright and universal over the whole face of the sky, *darting and gleaming, and commixing with inconceivable rapidity*, that one may see to read by the light which it diffuses.—*Smollett's Greenland.*

That of the year 1716, described by Dr. Halley, was visible from the west of Ireland to the confines of Russia, and to the east of Poland, extending at least near thirty degrees of longitude, and from about the fiftieth degree of north latitude over almost all the north of Europe; and in all places at the same time, it exhibited appearances similar to those which he observed at London.

There seems to me, no doubt, that this phenomenon is produced by rays of light passing the Earth; the immense velocity of the dartings, the corona which the phenomenon forms, the rays all tending in their movements to a central point in the zenith, and the prismatic colours which they exhit, bear very strongly in favour of this conclusion. May not the rays all tending to the same central point in the zenith suggest that they may be refracted by the dense atmosphere and cross there?

therefore, pass the earth, they would be refracted to a point of concentration at thatdistance from the surface of the atmosphere.

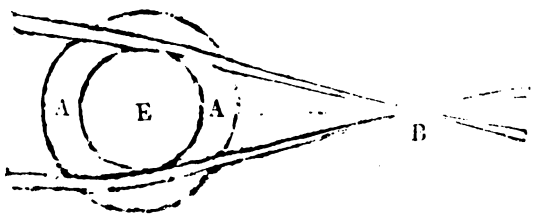
At this point of concentration they would cross, and diverge, at the very same angle at which they are refracted, to the focal distance beyond, making 8036 miles.

16,072 miles.

At the distance of 16,072 miles, I conceive they would have the power of illuminating, but I do not think beyond; however, for the sake of argument, let us suppose they would have the power of illuminating even at the distance of the Moon, and then let us trace the course the rays would proceed in, under the refraction of the Earth's atmosphere, and we will find that they would diverge to an immense distance on both sides of her, and that not a single ray could impinge upon her surface at all; let us, however, admit that they might impinge upon her surface, is it reasonable to suppose that a few rays (and few indeed they must be to be indiscernible,) which may pass the Earth, could equally illuminate the whole of the face of the Moon ?!!!

In illustration, let E be the Earth, AA the Earth's atmosphere, B the focus of the convexity of the Earth's atmosphere, and C the focal distance beyond the focus, at which only the

rays have the power of illuminating. If, therefore, the rays cross at the focal distance of 8,036 miles from the Earth's atmosphere, and diverge from that point at the same angle as




which they are refracted to it, it will be evident, when we consider the distance the rays will have to diverge to the Moon, that they will be at an immence distance from her on both sides, and consequently cannot impinge upon her.

Mr. Bonnycastle says, "There have, however, been Eclipses of the Moon, when in that part of her orbit nearest the Earth in which she has entirely disappeared; but these instances are very rare" "Hevelius," he says, "mentions one of this kind, which happened on the 25th April, 1642, when he was not able

to distinguish the place of the Moon, even with a good telescope, although the sky was sufficiently clear for him to see Stars of the fifth magnitude."

It is said that the limits of a Lunar Eclipse are twelve degrees from the node; this distance is equal to that part of a circle which the shadow of the Earth is equal to. I shall, however, endeavour to make this more intelligible, as the diameter of the Earth has been ascertained to be about three times as large as that of the Moon, the apparent diameter of the Earth's shadow at the distance of the Moon will be thrice as broad as the apparent diameter of the Moon. The Moon's apparent diameter has been ascertained to be about 31 minutes, which, therefore, makes the apparent diameter of the Earth's shadow, at that distance, to be about 93 minutes. This being the case, it requires the Moon to be within 93 minutes of the node before she can pass through any part of the Earth's shadow: No Eclipse, therefore, can take place unless the Moon is within this distance of the node at the time the Sun arrives at it.

In calculating in this manner, it strikes me, we may be less liable to err, for when an Eclipse takes place, if we ascertain the declination of the Moon, and compare it with that of the Sun for the time, we may be able to ascertain whether the Moon is really in the Earth's shadow or not, for I have not the least hesitation

in saying, that I cannot think she can be immersed in it whilst visible.* It is to be observed here, that whatever the declination of the Sun may be, north or south, that of the Moon must be within 93 minutes of the same declination, but if that of the Sun is south, that of the Moon will be north, and vice versa.

The tides have hitherto been supposed as the effect of an attractive power in the Moon; if this were the agent, however, it must be self-evident that the effect would be produced at all times the same, and not *only* whilst she is in the full. Does not the circumstance, therefore, of its being produced only when she is in the full, suggest that her illumination may be the cause?

Bernardin de St. Pierre, p. lx. says, "The tides are the half-daily effusions of the ices of one of the Poles, just as the general current of the ocean are its half yearly effusions. There are two general opposite currents annually, because the Sun warms, by turns, in the course of one year, the southern and northern hemispheres; and there are two tides every day, because the Sun warms, by turns, every twenty-four hours, the eastern and the western side of the Pole

* Independent of the reasons I have already given for being of this opinion, there seems to be still another of equal weight, which is, that if the Moon is immersed in the Earth's shadow, the cone directed to the Moon, as well as that directed to the Earth, must be at that time refracted by the same surface of the Sun; this, however, does not seem a reasonable supposition, as the same surface cannot be supposed capable of refracting two cones so different as *those* of the Earth and Moon.

that is in fusion. The same effect exactly is visible in many lakes situated in the vicinity of icy mountains, which have currents and a flux and reflux in the day time only. But it cannot admit of a doubt, that if the Sun, warmed, during the night, the other side of those mountains, they would produce likewise another flux and reflux in their lakes, and consequently two tides in twenty-four hours, as in the ocean."

"The retardation of the tides of the ocean, which is about twenty-four minutes the one from the other, arises from the daily diminution of the diameter of the icy cupola of the Pole in fusion. Accordingly the focus of the tides is removing farther and farther from our coasts. If their intensity is such, according to Bouguer, that our evening tides are the strongest in summer, it is because they are the diurnal effusions of our Pole, produced by the heat of the day in the sultry season. If at that season they are less in the morning than in the evening, it is because they are the nocturnal effusions which come from the other part of the Pole, and discharge themselves into the sources in the spiral direction of the Atlantic ocean, but in a smaller quantity."

"If, on the contrary, at the end of six months the strongest tides, that is, that of the evening become the weakest; and the weakest, that is, those of the morning, become the strongest; it is because they are then produced by

the action of the Sun on the south Pole, and the cause being opposite, the effects must be so likewise. If the tides are stronger one day and a half, or two days after the full of the Moon, *it is because that luminary increases, by her heat, the Polar effusions*, and consequently the greater quantity of water in the ocean. The Moon possesses a degree of heat, which not only evaporates water, as was ascertained by recent experiments at Rome and Paris, but which melts the ices, as Pliny relates in conformity to the observations of antiquity."

The above doctrine I decidedly subscribe to, being the most reasonable solution I have ever met with.

## CLIMATES AND SEASONS.

I do not conceive that the causes assigned, by the existing doctrine, are alone sufficient to produce the differences of Climates and Seasons, if the rays of the Sun, which shine upon the same place all the year, are supposed to have the same power.

The causes, hitherto, assigned for the difference of Seasons, are the shortness of the days, and, the obliquity of the Sun's rays in winter, and the opposite in summer. If this theory, however, makes it appear reasonable that the rays of light are less powerful as they are distant from the centre of the cone, how much more reasonably consequential will not those differences and changes appear? By this theory, the central and most powerful rays of the cone are, on the 21st December, 23½ degrees south of the equator and, with the other assigned causes, produce winter; and, on the 21st June, they are 23½ degrees north of the equator, and, with the other assigned causes, produce Summer: the rays which shine upon any place at and without the tropics in Summer, will be 47 degrees nearer the centre of the cone, and consequently much more powerful, but those which shine upon any place *within the tropics* will be so much nearer,

their situation is nearer the equator, as those which shine upon the equator will not be more than 23½ degrees distant at any season. Therefore the much greater heat between the tropics the nearer a place may be to the equator.

## CLOUDS AND RAIN.

I shall now endeavour to explain the production of Clouds and Rain after their first origin in the creation of all matter.

Clouds are, no doubt, moisture which has been evaporated from the sea, rivers, lakes, &c. in an imperceptible form, into the atmosphere; part of this moisture is capable of remaining in the atmosphere in a state of solution, and part at a great distance from the surface of the Earth in the form of white clouds; the superabundant quantity which cannot remain, owing to the expansion of caloric, is drove off in an expanded form, to places where less caloric exists, such as valleys, river-courses, tops of mountains, and to certain distances around the Sun, influenced by the repulsion of the Sun's heat, and the pressure of the exterior dense atmosphere; in the latter of these situations it is always (and sometimes in the others) condensed.

In the three first situations, when the general temperature of the atmosphere has been lowered, in consequence of the rays of light having been obstructed by a thin body of Clouds covering our horizon, or by Rain, this superabundant moisture will assume the form of Clouds, which will mark the course of the

rivers, and embrace the highest summits of the mountains in the closest manner.*

It is well known that the currents of air which we call wind, is the denser atmosphere rushing into higher rarefaction to recover the equilibrium of temperature; whilst we feel, therefore, this wind, it is evident that there must be much higher temperature beyond us which it is seeking; when, however, the rarefaction is highest in our horizon, the denser atmosphere will rush into it from places all around, where less rarefaction prevails, but, as the rarefaction with us will be able to repress and keep it at bay, our atmosphere will be perfectly serene; this dense atmosphere rushing to our rarefied horizon will bring the clouds of superabundant moisture that might be within its current, and press them in upon our horizon, until it is completely covered.

When this has taken place, and the dense clouds completely obstructed the passage of the direct rays of light, and the increase of caloric, which before kept up the rarefaction of the atmosphere, has, consequently, ceased, the temperature below the clouds will become progressively lowered until it actually condenses the under surface of them in the form of Rain.

This Rain will continue until the temperature in our horizon is lowered below that of some

* This may be frequently seen over the course of the Wag Water River, amongst the mountains in Lignanea, and *upon the tops of* the mountains above it.

other place; in this case a current of air will rush from our horizon to that place, and carry away the remainder of the clouds, when the rain will cease with us; this lowered temperature may only last for a very short time; for, after the rays shall have again acted for some time upon our horizon, a temperature higher than what prevails for a distance round, may be recovered, when a repetition of the same consequences may be produced. Rain, therefore, will be produced, with some intermissions, in the manner above explained, until the higher rarefaction of our horizon shall have been reduced: this would seem to explain how we have rain day after day about the same hour.*

This doctrine may be considered doubtful, because we are not sensible of a reduction of temperature calculated to produce this effect; this, however, we cannot possibly be sensible of, because the temperature near the surface of the Earth is kept up, in a considerable degree, by the accumulated heat making its escape out of the ground, at the same time that its effects are much more sensibly felt in consequence of the serenity of our atmosphere at the time. It is likewise to be considered that the caloric never was so high at the distance of the Clouds, as at and near the surface of the Earth, the distance of the former being greater from the point of concentration than the latter.

* I think the hour must be rather later every succeeding day, as the caloric has more to effect.

## ATMOSPHERE OF THE UNIVERSE.

I conceive that the difference in the constitution of our atmosphere from that which fills the endless expanse of the Universe, consists in its containing carbonic acid gas, and probably more hydrogen gas (in consequence of its containing moisture) than the other.

Although it is not allowed that hydrogen gas exists in our atmosphere,* because it has never been detected by any of the limited experiments it has been, and only can be submitted to, yet I have no doubt that it did exist as a constituent of the atmosphere, or water could not have been created as has been explained,† for I am convinced that before the atmosphere of the Universe was decomposed, no moisture existed in it. The natural inference therefore is, that the atmosphere of the general expanse of the Universe, beyond the operation of the caloric near the different bodies constituting the different systems, may be similarly consti-

* I have adduced the circumstance of a smell of sulphur being always concomitant with lightning, as an evidence that hydrogen exists in our atmosphere: This seems further strengthened by the same smell being always attendant upon electrical experiments. Is this calculated to justify a suspicion that *sulphur* may be *hydrogen* in a concrete form?

† It is well known to chemists that water can only be produced by the combination of oxygen with hydrogen in a *state of combustion*.

tuted as it was in the beginning, before materiality was created, and therefore that it may still contain the different elements which contributed to the formation of all matter, although they cannot be detected by our limited and powerless experiments; this seems to be proved in a very striking manner by the stones and other substances which have fallen out of the atmosphere upon our Earth, known by the names of

## ÆROLITHS, METEORS, AND FIRE-BALLS.

I am of opinion that these bodies which have fallen from the atmosphere upon our Earth, are produced in our atmosphere by a similar agency as created all matter, but in a different manner, and upon a very small scale. I conceive that the ignition and combustion which produced these stones, might have been elicited by compression between the rarefaction near our Earth, and the exterior dense atmosphere in their efforts for predominance; this compression might, simultaneously, have decomposed the atmosphere, and ignited its hydrogen; after this had taken place, I conceive the dense atmosphere rushed into the rarefaction (thus produced) and was decomposed, and that the disengaged elements exerted their elective affinities for each other, and formed the stones, iron,

&c.* I am further of opinion, that whilst the hydrogen, disengaged in this process, is ignited, and the combustion kept up, the phenomenon will last, and the stone or other body become larger, but the moment it is not ignited, or is engrossed by the other disengaged elements, it will cease, and the body be precipitated to the Earth, sometimes severed to pieces by the dense atmosphere recovering the equilibrium; this produces the loud report sometimes attendant upon the cessation of this phenomenon.

I am of opinion, when the phenomenon ceases in the above manner, that the amalgum has been formed in front of the combustion, which accounts for its wedge form, when it has been precipitated entire, instances of which have occurred. I am however well aware, that some meteors produce stones, and leave them behind them, making the appearance of a tail of ignited particles. An instance of this occurred between 8 and 9 o'clock in the evening, in the month of August this year,† when I saw a ball of fire about the size of my closed hand, darting from north-east to south-west, with a

* There seems to exist wonderful analogies throughout this theory, for even surphureous water has fallen upon the Earth; this seems to show that the same cause produces different results according to the combinations which take place, for water may reasonably be supposed to be the result of combustion, but the identity of the origin of this water *seems* established beyond a doubt, from its being *sulphureous*.

† *1824.*

double train of ignited particles behind it; the meteor ceased about a second after I observed it, but the particles which composed its tail retained their ignition for a second longer (gradually ceasing) until they disappeared. There can be no doubt that these ignited particles were bodies which lost their ignition gradually, and fell upon some part of the surface of our Globe: no noise was produced on its disappearance.*

* There is a description of a similar meteor in No. 313 of the Philosophical Magazine and Journal for May, 1824, p. 393, as follows:—

"On the evening of Saturday the 17th of April, about a quarter past ten o'clock, a beautiful meteor was seen to the northward of the village of upper Kianeil, parish of Borrowstowness; it burst forth with great splendour, illuminating the atmosphere, and proceeded with amazing velocity in a S E by E or S E by S direction, emitting a train of vivid sparks, which gradually became paler until it entirely disappeared. Its duration, the writer of this, who witnessed the scene, thinks might be about five seconds, during which period it passed over about a third of the visible atmosphere."

This meteor, it would appear, was seen during the whole of its course, from its bursting forth, until its disappearance, which latter produced no explosion, nor precipitated any stones: it had, however, a train of vivid sparks.

In No. 316 of the same Magazine, various meteors are described under the head of "*Progress of Science respecting Igneous Meteors, during the year* 1823."

"Accounts of the fire-balls which were seen in the States of Ohio and Pennsylvania in 1819, have been published by Professor Silliman, together with a valuable collection of observations on the splendid meteor, of that description which was beheld over a great extent of country in the United States, as also in Canada, on the 9th March, 1822."

"The first, which appeared in the evening of the 24th July, 1819, is described by Dr. Henry Manning, of Youngstown, Ohio, as a large meteor pursuing its course through the atmosphere in a direction nearly north. He had a clear

The motion of these meteors is produced by the progressive expansion of that part of the atmosphere which rushes into the rarefaction,

view of it for a few seconds before its explosion, and at that time; and about three minutes, by estimation, after the visible explosion, he heard the report, which resembled that of a heavy cannon fired in a still evening, at the distance of three or four miles. A gentleman who was in the township of Gustavus, precisely twenty miles north of Dr. Manning's situation, saw the light, and thought the sound succeeded in something more than a minute; the distance from Youngstown to the south shore of Lake Erie, Dr. M. states, is rather more than forty miles, and much of the country south of the Lake is still a wilderness, making it uncertain whether any discoveries will be made if meteoric stones have fallen." —*American Journal of Science*, vol. vi, p. 315.

"The only data for computation, afforded by this account, are the times which elapsed between the explosion and the report at the two stations; and from these we may infer that this meteor was much lower at the period of its explosion, than many others have been; its elevation probably not exceeding a mile. The proximity of the Lake renders it probable that the results of the explosion, if massive, were lost in its waters."

"The meteor seen in Chester county, Pennsylvania, on the 21st November, 1819, is described by the Editor of the American Watchman, and by Mr. S. Turney, of some place in the above county, about 60 miles nearly south of Easton, on the Delaware; from a comparison of whose accounts, its characters and phenomena appear to have been as follows: It was a "fire-ball," appearing to be a complete mass of fire, in which is said to have been combined all the redness of Mars, and the softer light of the Moon, the entire phenomenon being sublime beyond description. At what hour it appeared is not stated, but doubtless in the evening, for the first-mentioned observer says, "while standing in the open air we were surprised by a sudden flood of light, sufficient to enable us to read the smallest print." Mr. Turney also states its light to have been very vivid. The former describes it as having been about half the size of the full Moon *when first observed*, and Mr. T found that many competent *persons declared* that it was of about one-third of the appa-

acting against the exterior dense atmosphere in the same manner as that of fire-works, parti-

rent magnitude of that luminary. A well defined conical tail extended from it to the lenth of 4° or 5°; *but no sparks were observed.* When first seen by the Editor, (at Chester) it was from 50° to 60° above the horizon; and when first observed by Mr. Turney, at the latitude of about 45° in the north east; at the former place it passed in an east north east direction, a little to the south of the zenith; and it was estimated to have been about two seconds in progression before it was observed, whence it is inferred that it first appeared at about 30° above the eastern horizon: it travelled whilst within view here about 120° in the heavens, and in a period of not less than five, nor more than ten seconds; beginning to decline in brilliancy when at about 30° below the zenith, and in two seconds becoming invisible, at 30° above the western horizon, its tail, in the mean time, lengthening to 10° or 15° forming a narrow red streak of evanescent fire. Mr. Turney states it to have passed through his hemisphere in a very few seconds, and near Easton, where a sound was heard in its direction. It suddenly disappeared from him at about the altitude of 40° in the south or southwest. About three minutes after its disappearance, says the Editor of the American Watchman, a noise was heard resembling the discharge of a cannon, or distant thunder, and in a westerly direction: after the lapse of two, three, or four minutes, Mr. Turney observes, two reports were heard, the sound continuing for many seconds."

After making some observations respecting the various supposed signs of and reports produced by the above described meteor, the article proceeds as follows:

"Mr. Turney, in agreement with the view of the nature of these phenomena, which has within these few years become very general amongst scientific men, and which, perhaps, is the most satisfactory hitherto described, terms the meteor just described *a terrestrial Comet*, and suggests that it may be the same with that which passed over Connecticut, and cast down a shower of stones in 1807, its course being nearly the same. Upon this Professor Silliman remarks, "its size, as conjectured by Mr. Turney, is much less than the estimated size of that meteor*." As the examination of the conjecture would lead me into a question which

* American Journal, vol. vi., p. 319.

cularly rockets, with this only difference, that that of rockets is produced by the expansion of

I am not yet prepared to discuss, viz. whether, when a meteor of this description explodes, its entire nucleus falls to the Earth in the form of meteorites, as commonly believed,* or whether a portion only of its substance is separated and cast down, so that the main body of the meteor still proceeds on its course, as some writers have contended, and in which case the same meteor may be seen repeatedly. I must omit for the present some remarks, however, upon a subject which is involved in Professor Silliman's objection, which will be found in a subsequent page of this section, where Professor Dean's estimate of the magnitude of the great fire-ball of 1822 is stated."

"The collection of observations on the great meteor that passed over several of the northern Anglo-American States on the 9th March, 1822, together with the calculations founded on some of them by Professor Dean, are among the most interesting of the kind, and may rank with the observations and deductions respecting the fire-balls of 1719, 1758, 1771, and 1780, given respectively by Dr. Halley, Sir John Pringle, M. Le Roy, and M. Cavallo and others. In some respects, indeed, they are peculiarly instructive."

"From a comparison of these observations, it appears that this meteor was seen over a tract of country including the space from Portland, in the State of Maine, in long 70° 20′ west to Oxford, in Chinango County, New-York, in about long. 75° 45′, and from some part of Rhode Island, lat. 42° N. to Quebec, lat. 46° 50′. The track was, no doubt, considerably greater in extent, but the foregoing are the only definite limits for which data are afforded. The path of the meteor was from south-east to north-west, or more accurately, according to Professor Dean, the direction of its motion was south 34° west; and according likewise to his computations, it must have traversed a space of about two hundred and fifty miles between the zenith of Wilkesbarre, in Pennsylvania, and that of Essex, a village on the western shore of Lake Champlain."

"Mr. Doty, who observed this meteor from a point of the Mohawk Turnpike road, near Canagoharie, in the state of New-York, and who appears to have had it nearly in his

* This I decidedly think is the case.

their combustible contents, whereas that of meteors is by the expansion of the atmosphere.

zenith, estimated its diameter at from twenty to thirty feet. To other observers, according to their situation, and according, likewise, as I shall endeavour to shew in the sequel, *to the actual change of bulk and of figure in the meteor, it appeared of various sizes.** Some stating its apparent diameter at six feet, many comparing its size to that of the Moon, whilst to others who were still more distant from it, it had the appearance of a large shooting Star."

"It is described by every one as having been of extreme brilliancy, and that it must, indeed, have been intensely vivid, is evident from the circumstance, that the impression produced by it on the eye of one observer, induced him to state, "that it was more brilliant than the most vivid flashes of lightning, or even the meridian Sun." And though the contrast of its splendour with the previous darkness of night, doubtless had its share in producing such an impression, yet there are various instances on record, of meteors displaying great brilliancy, even when opposed to the meridian Sun.—The meteor observed at Cambridge in 1818, by the late Dr. Clarke, and that seen in Bretagne in 1814, by the Abbé de l'Anion, were of this description. *The most intense light of the American meteor, as in other cases, appears to have been emitted at the time immediately prior to the visible effects of its explosion.*† Thus at Quebec, from which place it must have been very distant, having been seen there and at Montreal nearly in the same direction, and where "the sky was clear, and the Moon nearly at full, in an opposite direction; the light of the meteor, when it divided, was so strong, as entirely to destroy the shadows of the Moon light, and throw them in a contrary direction." The visible explosion of this meteor is variously described by different observers. Mr. Doty relates, "that it soon began to extend itself to the north-east and south-west, increasing in extension, and decreasing in its flaming appearance, until nothing was to be seen but two detached parts of it rapidly moving in different directions towards the north-east and south-west." A writer in Sauersfield (Oneida) Intelligencer, states that it burst with a violence which seemed to throw all nature into convulsions. It discharged its massy balls of electric fire in

* See Page 92. † Ibid.

light'ning, I conceive, is produced in a similar manner, but, in most cases, propelled with

every direction, when all disappeared before they reached the ground.* When first observed by Colonel Page, of Burlington, in the state of Vermont, it appeared like a common shooting Star, which, moving south-westerly, and passing a little south-east of Procyon, where about one-third of the way from Procyon to Sirius, suddenly increased in great splendour, continued its course, flashing and sparkling east of Sirius, and disappeared apparently by extinction. The report produced by the explosion is said by Mr. Page to have resembled the noise of a distant cannon. At Troy, in the State of New York, two distinct explosions were heard within a very short interval of time, and the sound reached the ear of another observer at the same place in about seven minutes and a half after the disappearance of the meteor. At Herkimer, in the same State, an explosion was heard from the south, about four minutes after the meteor had passed, which resembled the discharge of four or five pieces of artillery. At Ballston Spa, two, and it was said three, reports were heard on its disappearance. The concussion according to Mr. Doty, sensibly affected several houses, *and was followed by a strong sulphurous smell that lasted fifteen or twenty minutes.*"

"The luminous tract left in the atmosphere by this meteor, is among the most curious phenomena it displayed, and shows in a particular manner its affinity with some other meteoric appearances. At Troy it left a luminous tract in the Heavens, which was not totally extinguished in several minutes after the meteor disappeared. The Sangersfield Intelligencer states, that it left in its train an astonishing mass of livid fire, which remained after the explosion for the space of ten minutes, and then gradually disappeared like the rainbow. According to the Bridgeport Courier, after moving with great velocity from north-east to south-west, "it left a trail of immense size and peculiar brightness." Capt. Wardner, of Windsor, in the state of Vermont, describes it as leaving in its passage a dusky reddish track, which continued, especially about the middle of its length, for two minutes.—At Quebec the track assumed the form of an arched chain

* *No doubt*, in consequence of having gradually lost their ignition.

too great velocity to form concretions : Stones have, however, been precipitated during light-

of fire, vividly delineated in the heavens, and concaving towards the Earth, which disappeared in a minute or two."

" The meteors with which these circumstances more particularly connect the present, are those which were seen respectively at Geneva and many other places, May 15, 1811. At Angers, London, and Poitiers, producing a meteoric stone, June 3, 1822, and at Paris, Caen, and other places on the sixth August in the same year. The first, as described by Professor Pictet, was a kind of a serpent of fire, bent back at the west-end, so as to approach the figure of the letter S, which became spread out in the lower part, and then successively assuming the shape of a horse-shoe, and a parabola, diminishing in brightness every instant, became reduced in seven or eight minutes to two bright points, and was then concealed by a cloud. The meteor of the 3d June, 1822, as seen from Poitiers by M. Boisgiraud, had the appearance of a beautiful falling Star, that left after it a luminous rectilinear train, containing a bright point; the inferior extremity of which took a spiral figure, its brilliancy gradually decreasing, and became divided into two branches, one of these gradually diminished to the point just mentioned; and this became slowly extinguished in a quarter of an hour after the first appearance of the phenomenon. The third phenomenon of this nature I have alluded to, was observed at Paris by M. M. Gay Lussac and Berthier, it was a large and beautiful luminous serpentine train of light, as thick as the wrist, occupying a space of about thirty degrees, and likewise containing a luminous point at the lower extremity; it continued full five minutes. At Caen this meteor appeared to descend vertically, giving out a light equal to that of brilliant lightning, *throwing out sparks*, and leaving a long luminous undulating tail *filled with sparks*."

Do not the foregoing extracts suggest that the reports, sometimes consequent to the extinction of this phenomenon, are occasioned by the propulsion of the stones, and that the propulsion of the stones is produced by the dense air rushing in, on the cessation of the combustion and consequent expansion, to recover the equilibrium? Is it not reasonable to conclude so, as where there were no reports there are no stones precipitated to the Earth?

*Do they* not likewise suggest as, where there were no re-

[illegible] The theory of the production of meteors and meteoric bodies, seems to be analogically borne out by lightning, for part of the horizon where lightning darts, is always overcast with heavy clouds, and the presence of heavy clouds is an evidence of the existence of a high state of rarefaction near the surface of the Earth, as explained under the head of Clouds and Rain (see page 88).

Whilst on the subject of the atmosphere, I will mention an opinion I have formed as to the cause which produces the symptoms experienced by all aeronauts and travellers who have visited mountainous regions, such as sickness, vomiting, lightness of head, and difficult respiration, even in such degrees as to endanger life.*

ports nor stones precipitated, there were sparks in their tails, (which never appeared in the other cases), that those sparks were stones, in a state of ignition, left behind them?

Do not all these circumstances seem to lead to the conclusion I have come to, i. e, that in the first case the stones are produced in front, and in the other behind the meteors?

* Acosta relates, that he once ascended one of the highest of the Andes in Peru, called Pareacaca, and that he went prepared, according to the best instructions he could get, with several more who had the like curiosity, but notwithstanding all his precaution, when he came near the top he was seized with such pains that he thought he should have fallen to the ground, and the rest of the company feeling similar emotions, they all hastened down as fast as they could, without waiting for one another. They were all taken with violent retchings, and not only brought up bile but a great deal of blood. This lasted for three or four *hours, till they* had descended to the lower part of the *mountain; but* it seems that the sickness generally goes off

The cause hitherto assigned is, that the air at such high elevations is too pure and subtile for animals to breathe: Baron Humbolt was of opinion that it was as much from want of oxygen as the rarety of the air.

I am, however, not inclined to assent to either of these opinions, for the following reasons:—It has been established by experiments, that the atmosphere contains the same proportion of the gases (which have been discovered

before they get to the bottom, and is attended with no ill consequence.

People who pass this ridge of mountains, in any part of these, for upwards of 500 leagues, are affected in like manner, but more in some places than in others. Acosta had passed the Andes at four other different places, and always felt a like disorder, but not so much as at Pareacaca, and the best remedy they found against it was to stop their mouths, nose, and ears, as much as possible.

It is to be remarked, however, that those who travel over the high chain of the Andes in Chili, called the Cordillera, are not affected in the same degree as when travelling over that part in Peru, but only with a difficulty of breathing, which is perceived more or less on the tops of all high mountains, notwithstanding they are considerably higher. Acosta tells us that there are some mountains of Peru in travelling over which, there is still greater danger than any yet mentioned: he tells us that there are mountainous deserts where a sudden blast of air sometimes strikes a traveller dead in an instant: he relates that General Castillo, marching over them with his army, great part of his men suddenly fell down dead, and that their bodies remained there without stench or corruption. However incredible this may appear, it seems to be confirmed by the reports of European seamen, who assert, that they have seen great numbers of men, women, and children lying dead upon the sands in Peru, and looked as fresh as if they had not lain there a week, but when they were handled, they proved as dry and light as sponge or *pieces of cork.*

ni ity, in the upper regions as at the level of the sea, the effects above mentioned cannot, therefore, be supposed to be occasioned by a want of oxygen. The rarefaction or lightness of the atmosphere, alleged by some as the cause, I do not conceive reasonable, for these qualities are only the effects of caloric, and we know that instead of there being a greater degree of caloric in the upper regions of the atmosphere, there is much less than at the surface of the Earth. I have been led, therefore, to conceive that the only reasonable cause seems to be the absence of caloric, which is the rarefying principle.

I conceive that the caloric at those high elevations is not sufficient to lessen the affinity of the atmosphere, so as to enable the lungs to disengage its oxygen for the purpose of vitality. The circumstance that the stomach and bowels of animals are affected by the piercing quality of the atmosphere is very striking, and may probably throw some light upon this subject. A Mr. Wyeth, a young American gentleman, whilst here, attending Chemical Lectures, informed me, that he has frequently taken a bladder half filled with air to the top of a mountain of considerable elevation, and invariably found when he had got to the top that it was completely inflated, and that on returning to the level land it gradually became flaccid, and at the bottom was found half full as before he *ascended*: There seems to be a close analogy

between the above and the effect produced upon an empty corked bottle when forcibly sunk in the sea, for the bottle comes up full although the cork is still in.* May not the bladder be inflated by the dense atmosphere finding its way in at the mouth, although tied, or at the pores of the bladder, which, although distended, are imperceptibly so to unassisted vision; may not, therefore, the sensations produced upon the stomach and bowels by the piercing air, be the effect of this heavy atmosphere, pressing with its greater power into and upon the viscera?

I cannot avoid adverting to the circumstance, that the bodies of those who lose their lives upon those elevated regions in Peru do not become putrid or offensive, but dry and light as sponge or cork, for there is no doubt, although the bodies are found upon the sea sand of Peru, that the persons did not lose their lives *there*, nor get into the state in which they were found *there*, but that they were brought there by torrents.

The state of the bodies so found, as also the circumstance that the part of Costillo's army which fell down dead, neither suffered from corruption nor became offensive, seem to point out that the cause was not the dryness of the atmosphere alone, but especially the absence

* This effect is supposed to be produced by the weight of the water forcing the cork in, and the air which occupied the bottle before, in its escape, forcing it into its situation again.

of caloric, for all decompositions require caloric, and in an equal degree to that which was necessary to their original formation. The moisture of the bodies might have been absorbed by the atmosphere, in which latter very little (if any) could have existed at such a great altitude. *

The circumstance mentioned in the subjoined note, that, although those parts of the Andes situated in Chili are considerably higher than those in Peru, yet the inconvenience experienced there is far less than on the latter, may, I conceive, be easily explained, when we look at the two districts upon a map. The latter seems to occupy a much greater extent of country, and to form various ranges, and the country is much intersected with rivers, whilst that part in Chili occupies but one range, and the country is very little intersected with rivers. The influencing circumstance, therefore, in Peru, (where the mountains are considerably lower) would seem to be local, arising from a greater extent of mountainous district, and a greater prevalence of moisture, and consequently density; a reference to a good map will countenance this conclusion considerably.

There seems to me, to be some analogy be-

* The atmosphere, at such high elevations, cannot contain an equal quantity of moisture as nearer the surface of the Earth, if indeed any at all, for I am of opinion that the *pressure* of the dense atmosphere there would prevent it, *unless* where very high rarefaction prevails) or condense it *into cloud*, rain, hail, or snow.

tween the effects produced in a highly heated room and upon high elevations, although the causes are opposite: In a highly heated room, a person will feel the symptoms of suffocation from an obstruction in the action of the lungs, and on high elevations, the respiration becomes quick and oppressed, (probably producing the same sensation). In the first case, I am of opinion that the symptoms may be produced by the obstruction of the usual action of the lungs by the oxygen, its disengagement rendering their usual action unnecessary. In the second, I conceive that the oppressed and quick respiration and other symptoms may be produced by the difficulty of disengaging the oxygen, and the consequently necessary efforts nature makes to supply the deficiency.

## METEOROLOGY.

" * Though the phenomena of the weather must have at all times attracted the attention of mankind, because their subsistence and their comfort in a great measure depended upon them, it was not till the 17th century that any considerable progress was made in investigating the laws of Meteorology. How desirous soever the ancients might have been to acquire an accurate knowledge of this science, their want of proper instruments entirely precluded them from cultivating it. By the discovery of the barometer and thermometer in the 17th century, and the invention of accurate electrometers and hygrometers in the 18th, this defect is now pretty well supplied, and philosophers are enabled to make Meteorological observations with ease and accuracy. Accordingly a very great number of such observations have been collected, which have been arranged and examined from time to time by ingenious men, and consequences deduced from them on which several different theories have been built. But Meteorology is a science so exceedingly difficult, that notwithstanding the united exertions of the first philosophers of the age, the phenomena of the weather are still very far

* Thomsons Chemistry.

from being completely understood, nor can we expect to see the veil removed till accurate tables of observations have been obtained from every part of the world, till the atmosphere has been completely explored, and the chemical changes which take place in it ascertained."

"*The changes which take place in the atmosphere, demonstrate in the clearest manner, that new combinations and decompositions are continually going on in it. On these chemical alterations the greater number of Meteorological phenomena depend; they may be considered as the result of the mutual action of the different component parts of the atmosphere, and would admit of an easy explanation, if we were thoroughly acquainted with all these substances, and with the chemical laws which govern their action.*"

"The most important Meteorological phenomena are:—1st, The changes which take place in the weight of the atmosphere. 2d, The changes which take place in its temparature.* 3d, The changes in its quantity by evaporation and rain, &c. 4th, The voilent agitation in which it is often thrown—The electric and other phenomena which sometimes accompany or occasion these precipitations and agitations —The consideration of these subjects, says Mr. Thomson, "shall occupy the six following sections." In these I shall not follow him, but

* These two seem to me to be concomitant as effect and cause, the former existing in proportion to the latter.

only quote such parts as I consider suited to my purpose:

"Sect. 1.—*On the Changes in the Weight of the Atmosphere.*—We have seen in the last chapter, that the barometer indicates to us the weight of a column of air extending to the atmosphere, and whose base is equal to that of the mercury at the level of the sea, where the column of air is longest, the mean height of the barometer is 30 inches.—This Sir George Shuckburgh found to be the case in the Mediterranean and the Channel, in the temperature 55° and 60°. M. Bouguer, on the coast of Peru, in the temperature 84°, and Lord Mulgrave in latitude 80°; the mean height of the barometer is less, the higher any place is situated above the level of the sea, because the column of air which supports the mercury is shorter. The barometer has, accordingly, been used for measuring heights. But if a barometer be allowed to remain in one place, the mercury does not continue stationary: sometimes it rises, and at other times falls, varying to the extent of several inches; of course, the weight of the air which balances the mercury must be subject to the same changes. Hence we learn, that the air in the same place is sometimes light and at other times heavy: differences which must be owing to changes in its quantity: the barometer *then* informs us, that the quantity of air

above any spot is liable to continual alteration, consequently, either the air accumulates in particular spots, while it partially abandons others, or part of the atmosphere must be alternately obstructed altogether, and restored again by some constant though apparently irregular processes."

"Between the tropics the variations of the barometer are exceedingly small; *and it is remarkable that, in that part of the world it does not descend above half as much, for every* 200 *feet of elevation as it does beyond the tropics.** In the torrid zone too, the barometer is elevated about two thirds of a line twice every day, and this elevation happens at the same time with the tides of the sea†."

"As the latitude advances towards the poles, the range of the barometer gradually increases, till at last it amounts to two or three inches."

"In North America, however, the range of the barometer is a great deal less than in the corresponding European latitudes. In Virginia, for instance, it never exceeds 1. 1.‡."

"The range of the barometer is greater at the level of the sea than on mountains, and in the same degree of latitude, the extent of the range is in the inverse ratio of the height of the place above the level of the sea."

"From a table published by M. Cotte, in

"* M. Cassau Jour. de Phys., April 1790, p. 268."
"† Ibid."
"‡ Trans. Philadel., vol. 2, p. 142."

in the Journal de Physique,* it seems exceedingly probable that the barometer has always a tendency to rise from the morning to the evening, and that this tendency is greatest between 2 o'clock in the afternoon and 9 at night, at which hour the greatest elevation takes place; that the elevation at 9 o'clock differs from that of 2 by 4-12th, while that at 2 differs from the morning elevation only by 1-12th; and that, in certain climates the greatest elevation takes place at two o'clock."

"From the observations of Mr. Luke Howard, as confirmed by Cotte, it appears that the barometer has a tendency to sink at new and full moon, and to rise at the quarters. This coincidence is greatest in calm and fair weather. The depression from the quarters to the conjunctions amount to 1-10th of an inch, and the elevation from the conjuctions to the quarters amount to the same quantity."

"The range of the barometer is greatest in winter than in summer. Thus at York the mean range of the barometer during October, November, December, January, February, and March, of the year 1774, was 1 42; and for the six summer months 1 16†."

"In the serene and settled weather it is generally high, and low in calm weather, when the air is inclined to rain. It sinks on high winds, rises highest on easterly and northerly

"* August 1796, p. 110."

"† *Manchester* Trans. vol. 4, p. 543."

winds, and sinks when the wind blows from the south*. At Calcutta, it is always highest when the wind blows from the north-west and north, and lowest when it blows south-east."

" The barometer falls suddenly before tempests, and undergoes great oscillations during their continuance. Mr. Copland, of Dumfries, has remarked, that a high barometer is attended with a temperature above, and a low barometer with one below the monthly mean."

" Such are the phenomena respecting the variations of the barometer, as far as they can be reduced under general heads. Various attempts have been made to explain them, but hitherto without any great degree of success.† The Theory of Mr. Kirven appears to me to be by far the most plausible, though it is not sufficient to explain all the facts. The following observations may be considered as a kind of abstract of his Theory except in one or two instances."

" It is evident that the density of the atmosphere is least at the equator and greatest at the poles; for at the equator the centrifugal force, the distance from the centre of the Earth, and the heat, all of which tend to diminish the density of the air, are at their maximum, while at the poles they are at their minimum. The mean height of the barometer at the level of the

" * Dr. Halley."

† I am of opinion that all oscillations of the barometer are caused by change of temperature.

sea all over the globe is 30 inches; the weight of the atmosphere, therefore, is the same all over the globe. The weight of the atmosphere depends on its density and height; where the density of the atmosphere is greatest, its height must be least, and on the contrary, where its density is least, its height must be greatest.—The height of the atmosphere, therefore, must be greatest at the equator, and least at the poles, and it must decrease gradually between the equator and the poles, so that its upper surface will resemble two inclined planes meeting above the equator their highest part*."

"During summer, when the Sun is in our hemisphere, the mean heat between the equator and the pole does not differ so much as in winter. Indeed the heat of the northern countries at that time equals the heat of the torrid zone. Thus, in Russia, during July and August, the thermometer rises to 85° ‡. Hence the rarity of the atmosphere at the pole, and, consequently its height will be increased. The upper surface of the atmosphere, therefore, in the northern hemisphere will be less inclined, while that of the southern hemisphere from contrary causes, will be much more inclined.—The very reverse will take place during our winter."

"* Kirwan's Irish Trans., p. 2, vol. 43, &c."
"† Dr. Gutheries Edin. Trans., vol. 2, p. 229."
‡ Does not this countenance my Theory of the Climates and Seasons?

" The density of the atmosphere depends, in a great measure, on the pressure of the superincumbent column, and, therefore, decreases according to the height, as the pressure of the superincumbent column constantly decreases.*

" But the density of the atmosphere in the torrid zone will not decrease so fast as in the

* On perusal of the foregoing Theory, it may be seen that I do not admit that attraction or gravitation produces the phenomena which have been attributed to it, but that they are the effects of the exterior dense atmosphere rushing in to recover the equilibrium (see 42 43); the mean height of the barometer, therefore, which has been found to be 30 inches all over the globe, I conceive is produced by this agency: This seems very strongly evidenced by the phenomenon explained in the above-mentioned pages. That the atmosphere is higher or lower, and more or less dense according to the degree of caloric which may exist in it, there is no doubt; but I cannot concede that the oscillations of the barometer are occasioned by the greater or less pressure of the superincumbent column of atmosphere, but by the expansion or condensation of the mercury in it, produced by the greater or less degree of caloric that may exist at the time, as in the case of the thermometer; for I conceive that the dense atmosphere, which is always rushing in upon the surface of the Earth to recover the equilibrium, (the visible expansion of which I have explained in page 42), always acts with the same uniform powers, (with the exception of the effects produced by the greater or less temperature of the atmosphere), producing the mean height of the barometer all over the globe.—I am further of opinion that the less mean height of the barometer, the higher any place is situated above the level of the sea is not occasioned by the shortness of the column of atmosphere, but by the progressive decrease of temperature, which exists as the distance of the place is greater from the point of concentration of the cone of rays; I ought to say, from the surface of the Earth, as the heat near the surface of our globe is considerably increased beyond the progressive heat, by its accumulation and *reflection.*

temperate and frigid zones, because its column is larger, and because there is a greater proportion of air in the higher part of this column.—This accounts for the observation of M. Cassan, that the barometer only sinks half as much for every 200 feet of elevation in the torrid zone.* The density of the atmosphere at the equator, therefore, though at the surface of the Earth it is less, must, at a certain height, equal, and at a still greater, surpass the density of the atmosphere in the temperate zones and at the poles."†

"A current of air is constantly ascending to the equator, and part of it at least reaches and continues in the higher parts of the atmosphere. From the fluidity of the air, it is evident that it cannot accumulate above the equator, but must run down the inclined plane, which the upper surface of the atmosphere assumes towards the poles. As the surface of the atmosphere of the southern hemisphere is more inclined during the winter than that of the south-

* Should not this be examined, whether the number of feets which the mercury sinks for every 200 feet of elevation, be not proportioned to the latitude of the place?"

† I conceive that the principal cause which prevents the barometer from falling so much in the torrid as in the temperate zones, is the greater power of the rays of light acting upon a place as they are nearer the centre of the cone, which producing more expansion of the atmosphere, prevents the air from being so much condensed as if less rarefaction existed; if an effect, consistent with the higher temperature of the temperate zones in summer be produced there than upon the barometer, will not the principal cause *of that higher temperature* (contended for in this Theory,) *react with it in* mutual evidence.

ern hemisphere, a greater quantity of the equatorial current of air must flow over upon the northern than upon the southern hemisphere, so that the quantity of our atmosphere will be greater during winter than that of the southern hemisphere. But during summer the very reverse will take place. Hence the greatest mercurial heights take place during winter, and the range of the barometer is less in summer than winter."

"The density of the atmosphere is in a great measure regulated by the heat of the place.—Wherever the cold is greatest there the density of the atmosphere will be greatest, and its column shortest. High countries and ranges of lofty mountains, the tops of which are covered with snow the greatest part of the year, must be much colder than other places situated in the same degree of latitude, and, consequently, the column of air over them much shorter.* The current of superior air will linger and accumulate over these places in its passage towards the poles, and thus occasion an irregularity in its motion, which will produce similar irregularity in the barometer."†

* The moisture in the atmosphere will be enabled to approach nearer the surface of the Earth in a more condensed state, for should the caloric, and consequently expansive repulsion cease, all the moisture which now exists in a greater or less state of expansion, according to the degree of caloric which may be acting upon it, would be condensed into water, and rejoin its parental source—the sea, and our atmosphere resume its primeval state.

† That there is an affinity of temperature between clouds

" Such accumulations having gone on for some time, the density of the air becomes too great to be balanced by the surrounding atmosphere; it rushes down on the surrounding countries, and produces cold winds, which

and lofty regions, or in other words, that moisture, which was expanded and drove off from high rarefaction, can retreat to, and remain upon the tops of mountains in the form of clouds, (from the cause already explained), is evidenced in a remarkable manner, when the horizon is covered with a body of thin clouds, or after rain, whereby the temperature of the atmosphere has been lowered: on these occasions clouds may be observed on the tops of mountains and over the courses of rivers, situations where they are scarcely ever observable when they are exposed to the full power of the Sun. Of evenings, when the Sun has descended near the horizon, and his power consequently has become much diminished, clouds may be observed issuing from between the long and the other mountains behind it, in a regular train, and rising up to the top of the high mountain above Liguanea, and others at the same time may be observed rising from behind the same mountains to the same situation. These clouds sometimes remain stationary in this situation for a considerable time, but when the Sun is declining, or has declined below the western horizon, they may frequently be seen stretching over towards the western horizon in a long train, as if they were acted upon by two principles, one urging them over and the other retaining them; it may be observable at the same time, that the greater part of them will be expanded as they proceed, and but a trifling proportion of them reach the western horizon. On these occasions, it may likewise be observed, that, as the dense clouds are expanded in passing over, waves of thin white clouds seem to be repelled towards the eastern horizon; these white clouds are much higher than the dense clouds; these processes, as they seem to go on simultaneously, has given rise, in my mind, to the idea that the clouds, which, whilst passing over are *expanded,* may be drove off to a higher region, and be there *recondensed into the* high white clouds: This seems greatly *countenanced, by these* white clouds appearing to be drove

raise the barometer. Hence the rise of the barometer which generally attends north-east winds in Europe, as they proceed from accu-

off towards the eastern horizon, probably by the repulsion of expansion. I am of opinon, that the dense clouds which collect upon the summit of the mountains, may be enabled to remain there some time, owing, probably, to the power of the dense atmosphere over them being lessened by the caloric still operating, but when that caloric decreases, as the Sun descends below the horizon, the dense atmosphere may become sufficiently powerful to force them over. Clouds may be observed almost every morning to rise from behind the St. Andrew's and Port-Royal mountains as the Sun rises, and ultimately be driven over towards the western horizon, and mostly expanded before they arrive there.—It would seem therefore, that a body of clouds of superabundant moisture may surround the Sun at different distances, as influenced by the power of the Sun, aided by local causes.

This idea seems to be countenanced by the circumstance, that a compact body of clouds will almost invariably be seen upon the western horizon after the Sun has set; at first there will be a clear part between this body of clouds and the horizon, but as our horizon moves round, they appear to settle down upon the horizon until they disappear altogether, when our hemisphere will not have a cloud in it: this body of dense clouds which settle on the western horizon may be the moisture of the clouds which were expanded in passing over from the eastern horizon, recondensed.

Although it is evident that clouds are arrested on the tops of mountains in corresponding temperature, yet I do not think that air is accumulated on high regions, but that the air which is there is denser, owing to the absence of caloric, in proportion as the place is removed from the point of concentration; therefore, as the rarefaction in the champaign country and the dense air upon the mountains are able to counterbalance each other, the air of the champaign country will be heated or cooled; whilst the rarefaction of the champaign country predominates, the dense air upon the high region will be repressed, but when that has become lessened, in whatever way, so as to lose the predominance, the dense air will rush down from the mountains in every direction, and cool the air in the low country.

mulations in the north-west of Asia, or about the Pole: hence, too, the north-west-wind from the mountains of Tibet raises the barometer at Calcutta."

"It is probable that considerable quantities of air are occasionally destroyed* in the polar regions. When this happens, the atmosphere to the south rushes in to fill up the void Hence

This is the reason that in the islands in the torrid zone, where there are no high lands, there are no land winds at night, which invariably prevail in those islands which are mountainous. It scarcely seems reasonable to suppose, that winds from high regions, which consequently must be cooler than what prevailed in the low country before can raise the barometer, and I much doubt whether the dense air from the mountains of Tibet can reach all the distance to Calcutta to raise the barometer there, for in the islands in the West Indies, the land winds, which only prevail during the nights, (when the Sun, and consequently its rarefying influence are absent), do not extend to sea more than 15 or 20 miles, if so far.

These land winds are almost always overcome, by about ten o'clock (sometimes earlier) in the forenoon of the following day, when the rarefaction in the low region has again become sufficiently powerful to repress the dense atmosphere upon the mountains; these land winds are, however, sometimes checked for several nights together in the summer season, when the sea breeze prevails night and day. The identity of the region whence the dense atmosphere rushes down at night, is clearly pointed out by the land winds blowing down from the high upon the low-land *in every direction*

* With all due deference to far superior acquirements and genius, I cannot subscribe to the destruction of an atom, being well aware *that not one can possibly be lost;* for, if it should please the Almighty to dissipate our Globe, and consequently ourselves, the components would return into their original atmosphere, and no more than fill the space. (See *page* 39).

south-west winds take place, and the barometer falls."

"As the mean heat of our hemisphere differs in different years, the density of the atmosphere, and, consequently, the quantity of the equatorial air, which flows towards the poles, must also be variable. Hence the range of the barometer is different in different years. Does this correspond to the mean annual heat, that is to say, is the range greatest when the heat is least, and least when the heat is greatest?* For in some years greater accumulations than usual take place in the mountainous parts in the south of Europe and Asia, owing, perhaps, to earlier falls of snow, or to the rays of the Sun having been excluded by long and continual fogs. When this takes place, the atmosphere in the polar regions will be proportionally lighter.—Hence the prevalence of southerly winds during some winters more than others."

"As the heat in the torrid zone never differs much, the density, and consequently, height of the atmosphere will not vary much. Hence the range of the barometer within the tropics is comparatively small; and it increases gradually as we approach the poles, because the difference of the temperature, and consequently, of the density of the atmosphere increases with the latitude."

"The diurnal elevation of the barometer in the torrid zone, corresponding to the tides, ob-

* This seems beyond a doubt.

served by M. Cassan and others, must be owing to the influence of the Moon on the atmosphere.* This influence, notwithstanding the ingenious attempts of D'Alembert, and several other philosophers, seems altogether inadequate to account for the various phenomena of the winds. It is not easy to account for the tendency which the barometer has to rise as the day advances, which seems to be established by M. Cotte's tables. Perhaps it may be accounted for by the additional quantity of vapour added to the atmosphere, which, by increasing the quantity of the atmosphere, may be adequate to produce the effect."

" The falls of the barometer which precede, and the oscillations which accompany violent storms and hurricanes, show us that these phenomena are produced by very great rarefactions, or perhaps, destruction of air in particular parts of the atmosphere.† The falls of the barometer too, that accompany winds, proceed from the same cause."

" The falling of the barometer which gene-

* This seems a very reasonable conclusion. I cannot divest myself of an idea that the expansive power of the Moon's light may have some effect in producing the high tides at or near full Moon, thereby lessening the power of the dense atmosphere rushing in upon its surface, for I cannot imagine, were those high tides solely the effect of the additional solution of the polar ice, by the additional influence of the Moon, that the effect could be produced at or near the equator in the space of one day and a half, or two days after full Moon.

† See note, page 118

rally precedes rain, remains still to be accounted for; *but we know too little about the causes by which rain is produced, to be able to account for it in a satisfactory manner.*"

In the West and East Indies there are two causes which produce winds which prevail there; the one is a general cause, and the other local. The general cause is the higher rarefaction which prevails between the tropics, which produces the trade-winds in the Atlantic Ocean, and amongst the West India Islands, and the monsoons in the Indian Ocean. The local cause is the greater or less local rarefaction.

As the general cause and its effects are perfectly understood, I shall say nothing upon the subject, but endeavour to explain how the winds blow in and near Jamaica, which may apply to the West India Islands in general, and together with what I have said on the subject, in explanation of Clouds and Rain, and in the different notes under this head, may lead to the conclusion that winds, however they may blow, are dense atmosphere rushing into a higher rarefaction to recover the equilibrium of temperature.*

* This seems strongly borne out by what Mr. Thompson says, in his System of Chemistry, page 408, "Winds appear usually to begin at that point towards which they blow: they must therefore be owing to a rarefaction or displacing of the air in some particular quarter, either by the action of heat or some other cause. This is more particularly the case when wind blows with violence. Hurricanes are usu-

* Kirwen's Irish Trans. p. 397.

In Jamaica, the wind which blows during the day, is from the south-east on the south-side,

formly preceded by a great fall of the barometer, and the wind after blows in every direction towards the place where the barometer stands so low.* One would be tempted, in this case, to suppose the sudden decomposition of a portion of the atmosphere. In 1740, Dr. Franklin was prevented from observing an eclipse of the Moon at Philadelphia, by a north-east storm, which came on about seven o'clock in the evening. He was surprised to find afterwards, that it had not come on at Boston till near eleven o'clock, and, upon comparing all accounts which he had received from the several colonies of the beginning of this and other storms of the kind, he found it to be always an hour later, the farther north-east for every 100 miles."

"From hence," he says, "I formed an idea of the course of the storm, which I will explain by a familiar instance. I suppose a long canal of water, stopped at the end by a gate; the water is at rest till the gate is opened; then it begins to move out, and the water next the gate is first in motion and moves on towards the gate; and so on successively, till the water at the head of the canal is in motion, which is last of all. In this case all the water moves indeed towards the gate, but the successive times of beginning the motion are in the contrary way, viz. from the gate back to the head of the canal. Thus, to produce a noth east storm, I suppose some great rarefaction of air in or near the gulph of Mexico; the air rising thence has its place supplied by the next more northern cooler, and therefore denser and heavier air; a successive current is formed, to which our coast and inland mountains give a north-east direction."—*Franklin's Philosophical Letters*, p. 389.

* This seems completely analogous, and therefore suggests that the high rarefaction which the dense air is seeking, is not situated where the barometer is lower. This likewise gives rise to an idea that the barometer is lowered by the dense atmosphere rushing all around into the current in succession, for if that was not the case, how could the circumstance of its rushing in all around become known, for I have explained under head "Clouds and Rain," that where the highest rarefaction prevails, the atmosphere will be perfectly calm and serene.

and from the north-east on the north-side, unless about December and January, (sometimes earlier, sometimes later), when north-winds generally prevail, influenced, no doubt, by the general cause, as the Sun is then at and near the farthest point of his southern declination: The wind which blows in the day is called the sea breeze, in contradistinction from that which blows at night, which is called the "land wind."

Almost every evening after the Sun has declined below the western horizon, and his rarefying influence has consequently ceased, the dense air upon the mountains rushes down all around the island to the low-land, and even has the power to overcome the sea breeze to the extent of from 15 to 20 miles at sea; this wind is called the land wind, in consequence of its existence upon and coming from the land in every direction towards the sea; this land wind is, however, sometimes repressed in the height of summer by the sea breeze for several days together.

It is worthy of remark that the wind which generally blows in the West India sea, is the north-east trade wind, but the direction of this wind is often altered near the land by the direction in which the low rarefied land is situated as to its course; this seems strikingly exemplified by what takes place on the south-side of Jamaica, where the north-east trade wind is changed into a south-east wind, by rushing in

upon the low rarefied land near the sea: The regular trade wind, however, blows upon the north-side of the island, as the low rarefied land lies nearly in its natural course. I am, however, well informed by Captains of Vessels which constantly ply round the island, that the land wind is neither so regular nor strong at night as on the south-side, in consequence, no doubt, of there being but a small extent of low rarefied land near the sea, the mountains approaching near the sea-shore. I shall now conclude, in the hope that I have said enough to make myself, if not (with the authorities I have quoted,) my subject, understood upon general principles.

The field to be explored is so extensive, that it is impossible we ever can ascertain where the local causes, which produce many variations from the general operate; we ought, therefore, to rest satisfied that some higher rarefaction must exist in the quarter to which the wind blows, than with us or whence it comes, for all attempts to discover farther than the general causes can only bewilder us.

A suggestion has offered itself that the electric spark which is produced by the machine—the flint and steel, metallic tube, &c. may be elicited by the compression of the intervening atmosphere; this compression, I conceive, may decompose the atmosphere (thereby producing an increase of temperature) and ignite its hydrogen gas. The supposed attraction of dif-

ferent bodies whose temperatures have been raised, I consider may be the effect of dense air seeking the expansion, and the repulsion of other bodies in the same state may be the effect of the repulsion of expansion..

To sum up all, I submit it to the Reader, if, after having perused the foregoing Theory, he can consider it reasonable that the Almighty Alchemist may have created all materiality by caloric, as is evidenced by many of its attendant phenomena, whether it is not reasonable to conclude that all the phenomena of nature (not even excepting that of the magnet), may not reasonably be attributed to the same agency, or latent caloric. May we not conclude so, particularly, as (so far our weakness permits us to judge,) neither materiality nor its attendant phenomena (the cause of which we can trace,) may have had existence without the agency of caloric, and as all may cease with it?*

* An idea has offered itself, that should it please the Almighty to withdraw the caloric altogether, the pressure of the surrounding dense atmosphere would be so great as to dissipate this Globe by slow decomposition. This conclusion seems to be borne out as not unreasonable, when we reflect upon the power of the dense atmosphere upon the piston of a pump, should the opening at the bottom of it be closed after the piston has been introduced; when this has been done, there is no power capable of drawing the piston, if it should fit the bore of the pump so close as to prevent any air passing; if this is the effect when such powerful caloric prevails, what would be the pressure if the caloric should be taken away?

THE END.

# ERRATA.

Page 3, second line, for "veins" read "reins."
—— 5, second paragraph, second line, for "succeed" read "succeeded."
—— 11, second paragraph, fifteenth line, for "the Earth was" read "the form of the Earth was."
—— 58, second paragraph, fifth line, for "44" read "41."
—— 62, eighth line from the bottom, for "rissen" read "risen."
—— 63, note, second line, for "signiture" read "signature," and for "Vitello" read "Vitellio."
—— 93, fifth line, for "until" read "when."
—— 95, note, twenty-eighth line, for "signs" read "size"
—— 99, note, [illegible] from bottom, for "are" [illegible]
—— 101, n[illegible] read "[illegible]

[illegible] which o[illegible]